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Electrical World

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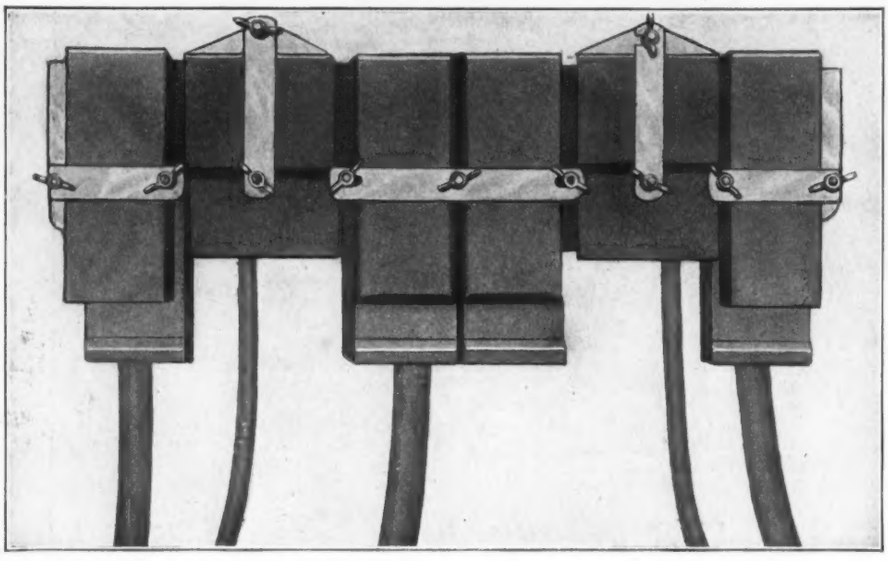

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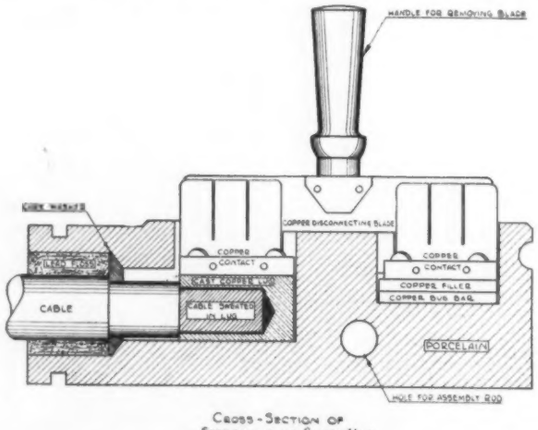

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Electrical World

THE CONSOLIDATION OF ELECTRICAL WORLD, ELECTRICAL ENGINEER AND AMERICAN ELECTRICIAN

Published by McGraw-Hill Company, Inc.

W. H. ONKEN, JR.

Editor

VOLUME 85 — *New York, Saturday, February 21, 1925* — NUMBER 8

Actual Data Needed on Secondary Distribution Systems

MANY companies have recently studied secondary distribution systems very carefully and have remodeled or rebuilt them to conform to the results of their analyses. The general trend has been toward the use of the three-phase, four-wire system and the replacement or elimination of the direct-current areas. But there are many exceptions to the general conditions, and even on a given property it has been found difficult to make a decision. Many elements of a technical and commercial character enter into the problem, and there is no way of measuring the influence of future inventions or developments on distribution. Motor and lamp ratings, service installations, unbalance effects, possibility of extensions, demands for different service requirements and actual cost determinations are difficult to weight properly.

On the whole, however, the three-phase, three-wire and four-wire systems and the two-phase, four-wire and five-wire systems must be studied in alternating-current secondary distribution, and it is to be hoped that those properties that have actually made the changeovers to these systems will see that the data become available to the industry so that other properties can make decisions on the basis of actual information instead of desk analyses. A correct decision is fundamental where such large investments are involved.

Heating a Problem in Measurement

ECONOMY dictates the use of machinery on a temperature basis, and many attempts are being made to institute this commercial practice. Offhand, it would seem easy to do this, but there is much in the practice other than an understanding of the fundamental laws of thermodynamics. The exponential heating and cooling curves of machines and cables are in themselves difficult to use in commercial operation, but many practical considerations enter to complicate the problem still further. The practical question reduces to a matter of limits and of accurate measurement. The limits are difficult to set under the varying conditions of installation and operation, and there yet remains to be discovered a simple and cheap measurement basis. Heating limits also involve a knowledge of insulation breakdown to a degree at present unknown.

For measurement purposes there exists the thermocouple for the measurement of maximum temperatures and the resistance-thermometer principle for determining average temperature conditions. Each has definite limitations. The "hot spot" must be located before the thermocouple can be placed on it to measure its temperature, and this in many cases is nearly impossible. Average temperature readings are of little value for many applications, since breakdowns usually result at points of greatest voltage or thermal stress, and these high points really fix operating limits. Both principles involve equipment, cost and operating refinements difficult to institute in commercial practice.

Before operation on a temperature basis can be called really successful, more fundamental knowledge, more nearly uniform design and manufacture and better means of temperature measurement must exist, but the idea is sound and progress is sure to be made.

Technical Features Accented at the Midwinter Institute Convention

THE electrical industry is unique in that it is founded on a quantitative science whose laws are formulated before practices are instituted. Thus the industry has been able to build intelligently since its inception, and much of the remarkable progress made is due to this fortunate circumstance. It follows also that electrical engineers have a keen appreciation of research work and honor those of their associates who fight on the front line against the remaining obstacles to a complete knowledge of electrical science.

More than fourteen hundred engineers attended the midwinter convention of the American Institute of Electrical Engineers to listen to advanced technical papers and to discuss research needs. The program was of an unusually high standard and reflected the major developments and problems in the art to an unusual degree. It speaks well for the Institute and for the profession to find such developments in the present day of commercial predominance.

The phenomenon of insulation breakdown continues to be the outstanding problem and greatest obstacle to commercial progress. The design of generators, cables, oil breakers, insulators and other fundamental equipment depends at present largely upon an understanding of insulation, and yet the best efforts of the best brains have been unable to understand the subject completely or to formulate its laws. In solid, liquid and composite insulation there are several theories, many data and some general knowledge of the action under electrical stress conditions, but there remains a vast field for investigation before a complete or even an adequate knowledge of the subject is obtained. Fortunately, well-organized research work is being conducted and results should follow.

Another leading topic at the convention concerned technical developments in motors. The commutator-type high-power-factor motor has been built and used and provides a new tool for industry. The full-voltage starting of induction motors was clarified to a large degree by the paper and the discussion on this subject. The complete development of alternating-current motors is yet to be made, and it is encouraging to find renewed activity on the part of motor designers.

The communication session revealed a real achievement in the art. This was recorded in papers covering the new polar-duplex telegraph system and the new

equipment developed for its use on long telephone lines. Other outstanding topics were treated in individual papers of merit, so that diversity, breadth and quality combined to give in a broad way a summary of progress made.

There must be no falling off in research work and technical analysis if the electrical industry is to progress, and every encouragement should be given the engineers to continue technical activities in the fullest degree. Technical knowledge is fundamental to commercial progress.

The Alternating-Current Commutator Motor—A Backward Child

THE papers by Messrs. Fynn and Weichsel on synchronous-asynchronous motors with a commutator, presented before the recent midwinter convention of the A. I. E. E., raise again the old-new questions as to "when" and "why not" regarding all kinds of alternating-current commutator motors. It is now nearly forty years since the first principles underlying these motors became well understood, viz., (a) that a series-wound motor will run on either direct current or alternating current, because the armature current and the field are reversed simultaneously, and (b) that if the brushes be shifted from the line of the field winding and short-circuited on themselves, a so-called repulsion motor is obtained. Since that time inventors, designers and theorists have developed many types of single-phase and polyphase commutator motors and have elucidated many points in their behavior and their limitations, while manufacturers and users have charged not inconsiderable sums on the debit side. The fact remains that this class of motors occupies only a subordinate position in the industry, although in fractional-horsepower sizes it has been found quite acceptable. In Europe it is also used to a considerable extent for traction purposes (at low frequency), and the polyphase induction motor with an accessory commutator (the Schrage principle) seems to be slowly but surely establishing itself in adjustable-speed industrial drives.

The principal reasons for a great amount of research done on commutator motors, in order to bring them to a practical stage, are two—the possibility of adjustable speed within wide limits and the possibility of improving the power factor. For traction or crane purposes there is also an important advantage in obtaining the desirable high starting torque together with suitable running characteristics. On the other hand, the very presence of a commutator and brushes is a drawback, especially in view of the fact that the "transformer emf." in the coils undergoing commutation cannot be compensated for in the same simple manner as that in which the inductance emf. is compensated by interpoles in a direct-current motor. Therefore the quality of commutation is bound to be somewhat uncertain. The increased cost, as compared with an induction or synchronous motor, is also an important consideration, and while many a user ardently desires an alternating-current motor with adjustable speed and unity power factor, his ardor cools appreciably when he learns about the extra cost.

It is worthy of note that in comparatively successful types of commutator motors the commuted winding does not carry the whole output of the motor, but only a part, the remainder being taken care of on the induction or synchronous principle, without the brushes. Herein seems to lie a promise of wider development and application of such motors, namely, using the commutator for power-factor control, for excitation, for speed regulation, and so on, and leaving the bulk of the power to be converted into mechanical work by other means. A steady progress of commutator motors can thus be insured without extravagant claims and without resulting setbacks. Of course, there is always a possibility of an epoch-making invention or discovery which will either make the commutator motor immediately acceptable on a large scale or relegate it to the scrap heap. However, although such an event is much more probable than that of almost anybody's unknown rich uncle suddenly dying in Australia and leaving him an uncontested fortune, yet its absolute "expectation" is far too small to discourage our inventors and designers from improving alternating-current commutator motors by the old tried step-by-step methods.

Wanted—More High-Grade Central-Station Power Sales Engineers

WITHIN the past year or so a competitive demand for high-grade power-sales engineers has been developing among the more progressive central-station companies. The situation is not yet critical, but it is likely to become so unless more definite policies are established to insure the supply of this type of personnel to the industry. It has already reached the stage where there is more or less rivalry among far-sighted managements to acquire the services of outstanding men in this department of highly specialized and yet extremely broad interests. This phase of the situation is not altogether unhealthy, and the real danger does not concern the present resources of electric utilities so much as it affects their early future needs.

Not a few central-station executives have overlooked the remarkable individual development which the power engineer has undergone since the war and so have taken his accomplishments very much as matters of course. Some of these men have been overburdened for lack of assistance, and others might tell weird tales of "horse-trading" salary adjustments if they saw fit. Be this as it may, the expansion of the industry and especially the pressing need of concentrating upon economic load-building programs in order to increase the investment turnover is beginning to put a premium upon the services of the best power engineers.

The time is ripe for putting into action a definite program to insure an adequate supply of future key men in this branch of electric utility service. Already the field is being combed for men combining unusual technical abilities with sound judgment, initiative, pleasing address and other qualifications which fit them to play the business game on even terms with the picked officers of the industrial army. It is time systematically to attack the understudy problem and to see to it that the right kind of cadet power engineers are obtained and trained in the best methods known to the industry. Unless early provision is made for a continuous supply of future power engineers of the most competent type, the day will soon come when money will not solve the problem of adequate personnel because of the time lost in failing to train the right kind of men in advance of the crisis. Service must go on in all its proper

aspects, and today is the day on which to begin to picture the opportunities and needs of central-station power engineering as a part of the industry's great job of electrifying the world.

Killing Mosquitoes with Sledgehammers

OVEREMPHASIS upon technique and company routine in selling central-station service to small consumers has scared off no little business in the course of utility history. Take the case of the small store and improved lighting. The advance of the salesman desiring to make a survey preliminary to recommending better illumination should be without blowing of technical trumpets. Elaborate measurements, voluminous drawings and long reports are very little needed. A 50-ft. tape and a notebook will produce enough survey material to enable a sound analysis to be made in literally hundreds of small stores. Experienced judgment goes a long way in "sizing up" the type and location of fixtures and wattage rating of lamps adapted to bettering conditions at reasonable expense, and expense means more than almost anything else to the corner grocery in the suburbs. Non-technical recommendations to store proprietors are absolutely essential, and an installation of better lighting in a "key" store in the small merchant's neighborhood as practiced by the Boston Edison company is more convincing than a dissertation on lumens by the central-station lighting salesman. The kitchen-lighting demonstration method can be applied in the small store at low cost. Good engineering in small installations means simplicity in layout, and there is no necessity to seek this class of business by methods adapted to analyses of large establishments.

Thoughts on Selling Purchased Power to Executives

IN SEEKING to bring about the adoption of purchased power instead of isolated-plant service, utility company representatives who have been particularly successful in presenting operating data and experience may forget that when talking to executives there are even better cards to play. One of them is the amount of money tied up in an isolated plant that could bring several times the return if invested in the owner's business. Another is the value of the space required for an isolated plant—how it might be leased at considerable profit, or how utilizing it for an isolated plant may hamper extension of the business. A third card, which can only be played successfully where a company has established a reputation for reducing rates voluntarily, is that if sufficient large power contracts are obtained a utility can reduce rates. Every firm that abandons the idea of an isolated plant for purchased power is helping itself as well as others to get a lower rate.

The first two arguments for purchased power can be used most effectively if presented merely as questions for the prospective customer himself to answer. By adopting this method the utility representative does not leave the impression that he is trying to mold his listener's opinion. Of course, it may be necessary, if the prospective customer has not already obtained estimates on the cost of a private plant, to present some figures on this point so that he can visualize the amount of money which would be diverted from the extension of his own business just to save what he thinks is the profit of the utility company, when it is really a small compensation for the use of invested money.

Unless the fact is called to the attention of a business or industrial executive, he usually does not realize how much faster he would turn over in his own business money that he may consider investing in an isolated power plant. Back in 1917 a utility company turned over its money only once in about six years. In 1922 the United States Census showed that the turnover period had increased to once in four and one-half years. Taking electric utilities as a basis, the census shows that commerce and industry turn over money much faster. For example: Food and allied products, twelve times as fast; leather, tobacco and vehicles, seven and one-half times; textiles and metals, nearly seven times; paper and printing, more than five and one-half times; lumber, five times; iron and steel, four and seven-tenths times; chemicals, four and one-half times, and stone and clay, not quite four times. These figures are based on gross income per dollar invested.

The value of the space necessary for an isolated plant can be easily estimated by the prospective customer. The chief thing is to make him consider it. What could he lease the space for if he didn't use it for a power plant? Or what handicap does building an isolated plant impose on extension of his business? In some cases the value of space alone has convinced hotel owners to purchase power and cease generating it.

A Term Is Still Needed to Designate Lighting Devices

THE actual device associated with a light source has possessed many different names throughout the centuries. Usually these names have been more or less consistent with the character and use of light sources, but at the present time there is much confusion, inconsistency and indefiniteness in their use. The English term "fittings" and our term "fixtures" are products of the age of gas lighting. Recently certain interests adopted the term "lighting equipment." This term includes "portable lamps" and what are commonly known as "lighting fixtures." Such terms as "equipment" and "fixtures" do not raise lighting devices above the level of plumbing and heating, notwithstanding the fact that usually they have a decorative and furnishing value. As a practicable inclusive term "lighting equipment" has merit. It certainly includes much more than such terms as "devices," "fixtures" and "portable lamps," and it is difficult to see how wiring, switches, convenience outlets, panels and all other appurtenances to electric lighting can be excluded from its meaning. It falls short of suggesting decorative value, and there is still a need for a term which applies only to the devices commonly known as "fixtures" and "portables."

To fill such a need the term "luminaire" was proposed and adopted by the Illuminating Engineering Society in the course of its work in standardizing terminology. The "fixture" interests did not adopt this term, but initiated the term "lighting equipment." It is difficult to see that the need for a term like "luminaire" has disappeared. In fact, the all-inclusive term "lighting equipment" seems to make this need greater. "Luminaire" has value in that it is a new word in our language; it is suggestive of decorative value, and its French origin promises the possibility of world-wide adoption.

Modern Substation Designs

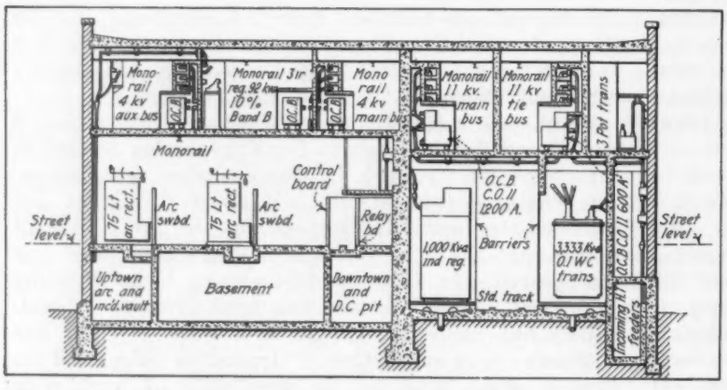
Isolation, safety and flexibility are governing elements in modern substation design. These are obtained by using phase isolation, truck type boards, fireproof compartments, insulated buses.

Upper view — A modern truck type switchboard for 4,000-volt service.

Center view—Exterior of a modern distribution substation.

Lower left—Compartment isolation in a new substation.

Lower right—A 13,000-volt bus installation more than 300 ft. long supplying twenty-eight feeders.



A.I.E.E. Midwinter Meeting Successful

Insulation, Machines, Communication and Electrophysics Were Topical Features of Technical Program of Convention — More Than Fourteen Hundred Members Attend Sessions — Abstracts of the Discussions

MORE than fourteen hundred members of the American Institute of Electrical Engineers attended the midwinter convention in New York, held February 9 to 12. The program contained twenty technical papers of merit. The special social and entertainment features noted in last week's news report helped also to make it one of the best conventions ever held by the Institute.

The phenomena of insulation as associated with cables and machines aroused the most discussion in the ranks of specialists in this branch of the industry, and the papers presented gave many new data on this subject and pointed out further ways to progress. An outstanding development in the art of communication was recorded in the papers describing the new metallic polar-duplex telegraph system for long small-gage cables.

Dielectric phenomena of a corona-like character in oils and gases were discussed, and a real advance was made in the way of new data and a clarification of theory. In addition, the newer types of commutator motors, produced in large part with the object of affording power-correction factor, were discussed at length.

Every technical session was well attended, and unusually good discussions followed the papers. In addition to their technical work, the members, as reported last week, enjoyed a smoker on Monday night, a public meeting on Wednesday night and an unusually fine dinner-dance on Thursday night. At Wednesday's meeting the Edison medal was presented to John W. Howell, and this ceremony was followed by an excellent address by General Mason M. Patrick on aviation.

Since most of the papers have been published, no abstracts of them are made in the following report, but the space available is used to report the oral discussions.

Committee on Electrical Machinery

H. M. HOBART, *Chairman*

"Thermal Time Constants of Electrical Machines"

A. E. KENNELLY
Harvard University

Proposal of a constant to be used in rating electrical machines based on the speed of temperature rise at a given load.

"Squirrel-Cage Induction-Motor Losses"

THOMAS SPOONER
Westinghouse Electric & Manufacturing Company

An experimental method for segregating the various no-load losses of a squirrel-cage induction motor.

"Complete Synchronous-Motor Characteristics"

J. F. H. DOUGLAS, E. D. ENGESET AND R. H. JONES
Marquette University

Complete characteristics of synchronous motors are determined experimentally. These characteristics differ materially from published curves determined by theory, and the difference is attributed to variations in synchronous impedance. Experimental data are given showing the factors affecting synchronous impedance.

"Factors Affecting the Design of Direct-Current Motors for Locomotives"

R. E. FERRIS
Westinghouse Electric & Manufacturing Company

This paper compares the different types of motors as regards the amount of power which may be developed in the available space on locomotives.

DISCUSSION on the above papers was confined almost entirely to the method of determining the thermal-time constant for machines. Several speakers pointed out that it was almost impossible to have one constant for the entire machine as all parts did not come up to constant temperature together, but that each element, such as the rotor and stator windings and rotor and stator iron, had a separate time constant. Consequently the application of the exponential form of equation was not favored. Professor Karapetoff thought that Professor Kennelly had not taken into consideration the accuracy of the formula itself. According to information available, the speaker said, this formula is inaccurate because of the variableness of the time constant for each part of the machine.

V. M. Montsinger of the General Electric Company said that the authors had applied the formula given to self-contained oil-cooled and air-cooled transformers. In his opinion correct results were not obtained. He then outlined the methods that he uses for determining the temperature rise in these types of transformers. C. N. Laffoon of the Westinghouse company said that he had conducted temperature tests on turbo-generators up to 35,000 kva. capacity and had found that their temperature curves follow the exponential law. However, this was only correct when the test data were taken directly on the bare copper. The results varied just as soon as the test was made on anything but bare copper. In his opinion it was not practicable to set a standard for determining time constants as so many variables enter the problem.

E. B. Paxton of the General Electric Company said that it would be possible to apply machines to better advantage if there was one method whereby temperature conditions could be easily determined. A. M. MacCutcheon of Cleveland wanted to know what use would be made of the time constant after it was determined. In his opinion it would be very dangerous to give this information to the user, since very often two machines of similar design and make vary widely as to time constant. It is very probable that results anything but correct would be obtained by the user when he tried to apply this information. Mr. MacCutcheon cited one instance in which two machines exactly the same in design varied in temperature by 15 deg. under the same load. More study should be given to the application of machines, he said, rather than spending the time in determining the thermal constant, the value of which is questionable.

Committee on Electrophysics

J. H. MORECROFT, *Chairman*

"Study of Direct-Current Corona in Various Gases"

F. W. LEE AND B. KURRELMEYER
Both of Johns Hopkins University

Determination of critical corona voltages for a number of gases over a wide range of pressure and an investigation of the physical processes involved in the formation of corona.

"Effect of Repeated Voltage Application on Fibrous Insulation"

F. M. CLARK
General Electric Company

Study of effects of 60-cycle voltages of different magnitudes on insulating properties of oil-treated and varnished fibrous materials and on mica.

"Corona in Oils"

A. C. CRAGO AND J. K. HODNETTE
Westinghouse Electric & Manufacturing Company

A study of the critical voltages of corona in insulating oil and the deterioration of oil subject to electrical potential.

"Stresses in Bus Supports During Short Circuits"

O. R. SCHURIG AND M. F. SAYRE
General Electric Company

An analytical method of maximum-stress calculations applicable to all cases of elastic conductors intermittently supported, based on mechanical tests of busbar structures, measurement of support stresses during short circuit and analyses of electromagnetic forces and of vibrations.

THE breakdown of solid and liquid insulation brought out in the papers presented caused a vigorous discussion, which generally tended toward modifying the Wagner pyro-electric theory of breakdown and brought out differences of opinion among specialists as to the

cause of insulation breakdown. Pro and con arguments on the effect of voltage stress in causing permanent and accumulative deterioration of solid insulation were presented. Most of the opinions expressed and the data produced supported the belief that deterioration occurred.

Dr. J. B. Whitehead said that Messrs. Lee and Kurrelmeyer had investigated the behavior of gases at low pressure and had linked their corona action up with the existing data on gases under higher pressures. It was shown that the empirical law of corona did not apply at low pressures. The paper of Mr. Clark indicated that insulation may or may not recover its initial strength after being subjected to voltage stress, and this conformed with the existing theory of absorption and the influence of temperature in changing absorption to conduction.

Dr. Joseph Slepian asserted that successive thicknesses of dielectric give a smaller total strength than that found in the aggregate of unit thickness tests. This may be caused, he thought, by a conduction action such as was indicated by Crago and Hodnette. He also pointed out the influence of time on the cumulative effect and explained the instability of breakdown on the basis of the ionization theory of collisions. J. A. Duncan, Brooklyn Edison Company, said it was necessary to search further before an understanding of the phenomena of oil breakdown could be understood and warned against generalizations to the effect that a cyclic breakdown occurred, since the cyclic action might apply to only one property of oil. E. S. Lee, General Electric Company, observed that test data showed that knowledge of breakdown phenomena seemed to reduce to knowledge of the actual happenings in a unit thickness of dielectric.

R. W. Atkinson, Standard Underground Cable Company, Perth Amboy, N. J., said the pyro-electric theory of breakdown was limited in application and should not be used in a generalized form. F. W. Peek, General Electric Company, stated that very high voltage applied to solid insulation had a permanent and cumulative effect in causing deterioration. He also said that the empirical law of corona formation did not apply to gases under very low pressures and in vacuo. D. W. Roper, Commonwealth Edison Company. held that actual tests on cables showed only about half the breakdown points to occur where hot spots could be located.

F. M. Clark thought the pyro-electric theory applied to many cases of insulation breakdown but that other factors were voltage effects and random effects. He said that care must be taken in making generalizations on the phenomena.

H. Halperin of the Commonwealth Edison Company showed experimental data on the breakdown of short lengths of cable tending to result in proving a permanent deterioration in insulation subjected to repeated high-voltage stresses.

The general conclusion at the end of the session was that many more data and a further development of theory are needed for understanding or controlling the breakdown of solid, liquid or composite insulation.

Committee on Power Transmission and Distribution

P. H. THOMAS, *Chairman*

"Artificial Representation of Power Systems"

H. H. SPENCER AND H. L. HAZEN
General Electric Company

A description of artificial transmission networks composed of small laboratory apparatus, showing results obtained on several typical problems. Great accuracy is claimed.

"Power-System Transients"

V. BUSH AND R. D. BOOTH
Both of Jackson & Moreland

A qualitative discussion of power-system stability under transient conditions, followed by an outline of a point-by-point scheme of analysis which takes into account the inertia of machines, field transients, etc.

"Testing Impregnated-Paper-Insulated Lead-Covered Cables"

EVERETT S. LEE
General Electric Company

A study of the value of the present methods of cable testing and suggestions as to the methods which should be continued to obtain the most trustworthy evidence which it is possible to get at the present time.

"Predicting Central-Station Demands and Outputs"

F. C. RALSTON
Philadelphia Electric Company

THE discussion on the papers by Spencer and Hazen and by Bush and Booth ranged around the real advance that has been made in power-system analyzation. Several speakers pointed out that the point has now been reached where actual conditions on complicated interconnected systems can be predicted with great precision no matter what happens. Professor Karapetoff outlined very clearly another analytical method of studying the conditions in large systems. The charts advocated by Messrs. Bush and Booth were criticised by C. L. Fortescue. In his opinion the circle diagram for determining conditions on a transmission system is more accurate than the charts used by the authors. He also objected to the short-cut methods employed and said they should be eliminated as they very often lead to confusion rather than to a simplied analysis. Improvements in the operation of a system depend upon several things, among which his company, the Westinghouse Electric & Manufacturing Company, favors the following: (1) High-speed excitation in which the excitation of the machine is varied practically as soon as any change in the system occurs; (2) the installation of synchronous condensers at intermediate points of the system; (3) high-speed oil circuit breakers; (4) better methods of governing. In Mr. Fortescue's opinion, there was a great deal of room for improvement in governing methods.

F. G. Baum pointed out that formerly transmission systems always lagged behind power stations and transformers. With the use of the 220,000-volt system transmission lines are now commensurate with the power plant and transformer. However, with this condition it is very necessary that synchronous condensers be used, and this simplifies the problem of system interconnection as condensers can be the clearing house of the reactive kva. just as one or two power plants in a system can operate on a base-load plan, the fluctuations being taken up by other apparatus. It appears that with 220,000-volt operation there is now a system that will stand up under practically all weather conditions.

There was a great deal of discussion on Mr. Lee's cable-testing paper, particularly as regards the suitability of several of the tests now being employed. There seems to be a decided tendency to use higher test voltages and longer times of application in tests on reel lengths and samples, and this seems to be a step in the right direction, according to the general discussion, for it tends to eliminate weak spots which have always been the cause of trouble. Another matter brought up was that there has always seemed to be a serious misunderstanding regarding the use of the dielectric strength tests.

An admirable discussion on this subject was presented by D. W. Roper. This is given at length elsewhere in this issue.

W. F. Davidson of the Brooklyn Edison Company pointed out that there are a great many things which cannot be learned from short-time tests or even from tests of several hours' duration. Several operating companies using cables at the higher operating voltages have lately found signs of very slow but noticeable deterioration. In many cases this has been accompanied by the formation of a substance commonly known as "X," "wax" or "cheese." Efforts to produce this substance in the laboratory have generally been unsuccessful, except when the time of test has been prolonged to many hours. This experience would seem to indicate the desirability of making tests on samples of cables using a voltage only slightly—say 50 per cent—in excess of the rated voltage and making a thorough examination, including chemical tests, after two or three hundred hours. Mr. Davidson pointed out that the data presented by Mr. Lee tend to show that insulation resistance as a test was not very valuable and might well be left out of specifications. However, according to Mr. Davidson, there seems to have been a value that the author of the paper overlooked. The user of the cable is vitally interested in obtaining cable with uniform qualities—999 ft. of good cable cannot keep a line going if one foot is defective—and it was his opinion that uniform cable will show reasonably uniform insulation resistance.

Several speakers spoke of the kenotron test method, saying that it embodied real advantages in size of testing equipment and ease of testing. Mr. Davidson said that a test set designed for 200,000 volts from conductor to conductor with a 250-milliamp. output had been built and mounted on a 6-ton motor trailer for the Brooklyn Edison Company. Particularly important in Mr. Davidson's experience, he said, was the fact that on the Brooklyn system using this comparatively high direct-current voltage no evidence indicating damage to the cables as a result of the repeated direct-current tests had been noted.

The general conclusion at the end of the discussion seemed to be that there is a great deal of research work to be done by the utilities and the manufacturing companies.

Committee on Electrical Machinery

H. M. HOBART, *Chairman*

"A New Alternating-Current General-Purpose Motor"

H. WEICHSEL
Wagner Electric Corporation

Description of an induction motor designed to operate at high power factor, at synchronous speeds with normal loads and having high starting torque.

"The Single-Phase Induction Motor"

L. W. PERKINS
Westinghouse Electric & Manufacturing Company

The operation of the single-phase induction is presented according to the cross-field theory as distinguished from the theory of oppositely rotating fields. This theory allows the use of simple mathematics and does not neglect factors neglected in other theories.

"Effect of Full-Voltage Starting on Induction Motors"

J. L. RYLANDER
Westinghouse Electric & Manufacturing Company

Experimental tests on starting squirrel-cage induction motors. A study of such starting-in service and of the bracing of induction-motor coils is included.

"Another Form of Self-Excited Synchronous Induction Motor"

VAL A. FYNN
Consulting Engineer

Description of a synchronous induction motor. The starting, synchronizing, synchronous-load and asynchronous-overload periods are analyzed with reference to synchronizing torque, automatic compounding and weight efficiency.

PROF. CHARLES F. SCOTT in discussing Mr. Weichsel's paper pointed out that in construction and operation the Fynn-Weichsel motor is a very simple machine and its performance is substantially that of a combined induction and synchronous motor. With Mr. Fynn's new motor better performance at a sacrifice of more parts has been accomplished.

The Fynn-Weichsel motor has been in service and has demonstrated that it is useful, according to Prof. W. L. Upson of Washington University, St. Louis. He said that the commutator and any troubles that might arise from its use were not nearly so bad as in other machines with commutators. The very small air gap used in this machine has benefited its performance. He thought that it would be highly desirable to have a comparison made between the Fynn-Weichsel motor and a salient pole type of synchronous motor.

R. E. Ferris of the Westinghouse company thought that the higher cost of maintenance and factors affecting the continuity of service made it desirable to keep away from any added complications such as are met with in a commutator machine. All double-winding machines have complications. Discussing Mr. Rylander's paper, Mr. Ferris said that the type of insulation used on the end winding depends upon the method of ventilation employed. He also thought that it was very important that proper and adequate bracing be provided for starting induction motors on full voltage. Auto-starters with suitable taps must be used whenever this bracing is not sufficient.

After congratulating Mr. Fynn on his work along a single line of design, Prof. Vladimir Karapetoff said that he would like to see the theory of machines gone into more thoroughly and recorded before the Institute. In this way it would be possible to prevent any discrepancy in the theory from creeping in. Professor Karapetoff desired to know what happened during load changes to the resultant field in the four-brush machine described by Mr. Fynn. He pointed out that the curves given in Mr. Weichsel's paper for open-circuit voltage in secondary windings and across the commutator and the speed-torque curves were not entirely correct as the effect of the direct-current winding had not been considered. In his opinion, these curves should be revised to take this into consideration.

Referring to Mr. Perkins' paper on the single-phase induction motor, Professor Karapetoff criticised the author because he had not taken into consideration the work that had preceded his. There seemed to have been a duplication of investigations which could very properly have been avoided. What is desired when analyzing any machine is an interpretation of what actually happens in the machine from one instant to the next. Professor Karapetoff advocated the use of higher mathematics, saying that engineers should not be content to use the ordinary methods of analysis when a much simpler one could be had by the use of higher mathematics.

L. W. Perkins, in speaking of Mr. Fynn's paper, said that the addition of brushes and commutator windings increased torque. There actually results a constant torque plus a double-frequency torque, a result which is obtained with the two-brush machines of the initial design, so why is it necessary to add two more brushes as has been done by Mr. Fynn in his new motor? In discussing machines of this general type, he said that they were inherently more costly than the induction motor as they are induction motors with added devices. Consequently, until a premium is obtained for their use on central-station lines, it would not be advisable to bring them out on a commercial basis. No high-power-factor motor should be brought out until a premium is included, in order that the premium may pay for the added first cost and operating costs involved.

A very interesting comparison between the induction motor and the Fynn-Weichsel machine was made by W. C. Kalb, Corliss Carbon Company, Bradford, Pa. In a mill pulverizing anything to a certain predetermined mesh an induction motor does not give perfectly uniform results, owing to the slight changing of speed at various loads. But with the Fynn-Weichsel unit a very uniform speed is obtained because of its synchronous characteristics. In case it is enough overloaded to bring it to the point where it operates as an induction motor, there is a decided change in speed, and this may be noticed by the change in tone of the motor. Thus it is possible to detect very easily this change in speed and to stop the operation before any serious change in product occurs.

F. G. Baum spoke of the "brute" action of the induction-motor load on any system. Even if a system is operating at 80 per cent power factor, extremely high losses result, and in the power station the excitation current must be approximately 50 per cent greater in order to take care of the reactive-kva. load. If anything occurs that disturbs the stability of the system, very serious trouble will result.

That the Fynn-Weichsel motor has a real field of application was brought out by R. E. Doherty of the General Electric Company. This, he said, is true both as regards power-factor correction and in the manner in which the motor carries its load owing to its constant-speed characteristics. He then pointed out that very noticeable advances in the design of synchronous motors have been made and that economic factors will determine in the future whether the ordinary synchronous motor or the commutator type should be used.

Mr. Weichsel thought that Mr. Rylander's method of attack was excellent. With problems of this kind it is well to have a physical conception of what actually happens, even if it is impossible to have a thorough mathematical conception.

Committee on Communication

O. B. BLACKWELL, *Chairman*

"Theory of Probability and Some Applications to Engineering Problems"

E. C. MOLINA
American Telephone & Telegraph Company

Explanation of the theory of probability and illustrations of its use in predicting probable telephone-plant loads under various conditions.

"Design of Distortionless Power Amplifiers"

E. W. KELLOGG
General Electric Company

A discussion of the problem, in connection with radio receiving and transmission, of obtaining the maximum output possible from an amplifying vacuum tube while keeping the distortion at a negligible amount.

"Metallic Polar-Duplex Telegraph System for Long Small-Gage Cables"

J. H. BELL
Western Electric Company, and
R. B. SHANK AND D. E. BRANSON
Both of American Telephone & Telegraph Company

Description of a new telegraph system which may be superposed on a telephone toll circuit. The operating current of the new system is of the same order as that of the telephone circuit on which the telegraph is superposed.

"Voice-Frequency Carrier Telegraph Systems for Cables"

B. P. HAMILTON AND H. NYQUIST
Both of American Telephone & Telegraph Company, and
M. B. LONG AND W. A. PHELPS
Both of Western Electric Company

A telegraph system which uses frequencies within the voice range and is especially adapted for operation on long four-wire cable circuits, ten or more telegraph circuits being obtainable from one four-wire circuit.

"Polarized Telegraph Relays"

J. R. FRY
Western Electric Company, and
L. A. GARDNER
American Telephone & Telegraph Company

The design of two polarized telegraph relays for use on metallic telegraph systems or carrier systems. One relay is for general application and the other for operation under severe and exacting circuit conditions.

THE theory of probability applies to many electrical engineering problems in communication and transmission, in the opinion of those who discussed the paper of E. C. Molina. A. E.

Hunt, American Telephone & Telegraph Company, indicated certain problems in long toll circuits to which this theory applied and also showed its use in determining the effects of static interference in radio reception. Impedance irregularities arising from several causes occur in a random manner, and the theory of probability is useful as a check and in design of lines. Bassett Jones pointed out that the theory of probabilities was based on no fixed mathematical methods, but used data and any convenient mathematical tool to arrive at results that checked with common sense.

A discussion of distortion by E. B. Loughran indicated experimental checks of the results obtained by Mr. Kellogg in his paper, but further discussion brought out the fact that seldom was more than one modulator tube used with an amplifying tube. D. F. Whiting, Western Electric Company, said that the production of a distortionless loud speaker now warranted closer design of tubes to eliminate distortion.

The development of the new polar-duplex system of communication and the necessary equipment to make it operate brought out very commendatory remarks from several members.

Committee on Instruments and Measurements

A. E. KNOWLTON, *Chairman*

"Electrical Measurements of Physical Values"

PERRY A. BORDEN
Hydro-Electric Power Commission of Ontario

Use of electrical means for measuring many physical quantities, including temperature, stress, strain or small changes in physical dimensions, flow of liquids or gases, angular and linear velocities, work, radiant energy, chemical and molecular condition, and physiological conditions, and for navigational measurements.

"Use of the Oscillograph to Measure Mechanical Phenomena"

HARVEY L. CURTIS
Bureau of Standards

Adaptation of the oscillograph to measure mechanical phenomena of short duration, rapid motions, short time intervals, velocity, etc.

"Temperature Errors in Induction Watt-Hour Meters"

I. F. KINNARD AND H. T. FAUS
General Electric Company

A study of errors due to changes in magnetism caused by temperature variations and suggested magnetic material and construction to reduce the errors.

"Storage-Battery Electrolytes"

G. W. VINAL AND G. M. SCHRAMM,
Bureau of Standards

Effect of various impurities in electrolyte on the life of the plates and the battery performance.

FOUR papers presented under the auspices of the committee of instruments and measurements brought forth a lively discussion which covered the accuracies of various methods of testing, further possible applications of the oscillograph and the effect of impurities in storage-battery electrolytes.

Dr. H. B. Brooks of the Bureau of Standards pointed out that more accurate results could be obtained for acceptance tests when indicating watt-meters are used. He did not favor the use of watt-hour meters for this purpose. In the paper by Messrs. Kinnard and Faus various tests in which the watt-hour meter was used were reported, and Dr. Brooks questioned the accuracy of the results. Mr. Kinnard replied that as long as the ambient temperature remains constant temperature errors do not creep in, provided that the meters have previously been allowed to come up to operating temperature. In his opinion, errors in watt-hour meters due to low power factor can most readily be corrected by means of lag coils, one coil with a high-temperature coefficient being used on the current coil and a second coil with a low-temperature coefficient being used on the potential coil. F. V. Magalhaes of the New York Edison Company maintained that the use of "thermalloy" in the jaws of the watt-hour meter magnet for correcting temperature errors was a decided step forward.

Mr. Kinnard said that errors due to low power factor can be reduced by lowering the resistance of the potential coils and that when this is properly done the lagging plates can be dispensed with. The use of other alloys rather than thermalloy, which is a series of copper-nickel-iron alloys, was discussed by J. Slepian of the Westinghouse company. Mr. Kinnard said that these other alloys may have a possible application, but in his experience thermalloy can be better controlled, particularly in its manufacture.

J. R. Craighead of the General Electric Company in discussing Mr. Borden's paper brought out the questionable state of medical measurements. Many "fake" methods are being advocated, and the electrical industry should be very careful not to further them. I. M. Stein of the Leeds & Northrup Company also spoke of ridiculous statements regarding the value of certain medical measurements. However, he contended that the industry should distinguish between good work and fake apparatus and should help those men who are seriously investigating the application of electrical measuring methods to the medical profession.

E. S. Lee of the General Electric Company, speaking of the use of thermocouples for the measurement of the so-called "hot spot," thought that this term should be done away with entirely. The thermocouple measures the temperature of an area of about $\frac{1}{8}$ sq.in. or smaller, and it is almost impossible to make this spot coincide with any particular "hot spot." For measuring apparatus where this does come in, much more satisfactory results can be obtained by the use of the resistance measurement methods. Mr. Lee did not, however, argue that thermocouples should not be used, conceding that there are still a great number of applications for this instrument.

The apparatus described by Mr. Curtis for placing definite time intervals on oscillograms was discussed by Mr. Craighead, who thought that these indications should be arranged to reach across the entire film instead of only part way, owing to the very material contraction and expansion of the film when it is developed.

Mr. Magalhaes objected to the use of the arc light in the oscillograph suggested by Mr. Curtis, saying that it is very hard to use this type of light in the field. He thought it was desirable to use some form of incandescent lamp. The use of an incandescent lamp, Mr. Curtis replied, with a ratio of light from the two sources of from four or five to one, was not at present entirely satisfactory. He thought that the manufacturers should design an arc lamp for oscillograph use. This would not be very difficult.

In a discussion presented by C. E. Skinner for J. W. Legg of the Westinghouse company it was set forth that there was a broad field opening for the recording of non-electrical phenomena by electrical methods. Mr. Legg also described the use of an incandescent lamp for an oscillograph. In this instance the lamp was flashed and very good results were obtained.

Dr. C. H. Sharp of the Electrical Testing Laboratories pointed out that the oscillograph is a one-turn instrument and thought it would be desirable to have many turns in the field so that instead of operating as an ammeter the instrument would operate as a voltmeter, thereby giving much more sensitiveness with small currents.

F. G. Baum described the use of an oscillograph in determining the source of vibration in the penstock of a 40,000-kva. turbine. By using the oscillograph it was possible to determine where the cause of vibration lay. In this it lay in the runner of the hydraulic unit. Another possible application pointed out by Mr. Baum was the studying of vibration in long transmission spans when they were first put up.

C. L. Dawes of Harvard University discussed some research work on high direct-current amplification that is being carried on at the Harvard Engineering School.

Dr. J. L. Woodbridge of the Electric Storage Battery Company, in discussing the paper on storage-battery electrolytes by Messrs. Vinal and Schramm, spoke of the handicaps of older methods for studying the effect of impurities in the electrolyte and said that the new method used by the authors was bound to throw much light on the subject. The tests reported in the paper were for a single set of conditions, and Dr. Woodbridge hoped that the authors would continue their work and cover various temperatures, conditions, densities of electrolyte and variations in the load drawn.

Mr. Young of the American Telephone & Telegraph Company advocated the use of lead-alloy terminals for batteries instead of copper and brass, saying that upon corrosion the latter introduces certain impurities in the electrolytes. Mr. Howard of the Electric Storage Battery Company said that even though the use of antimony in plates is quite universal, with resulting traces of antimony in the electrolyte, he had never found any gas given off because of the antimony. He said he had found traces of arsene gas, which is very poisonous, but with proper ventilation there is very little danger from this source.

In closing, Mr. Vinal said that the Bureau of Standards had made a few further tests as had been suggested by Dr. Woodbridge, but these had in no way been complete.

Lamp Developments in America

Edison Medalist Traces History of the Lighting Unit, Recounting the Repeated Improvement in Its Efficiency and Quality—The Three Steps in Filament Manufacture—How Present-Day Lamps Are Made

By JOHN WHITE HOWELL*

AS A MAN gets along in years his mind often turns back and dwells on the past, and some of my pleasantest thoughts are remembrances of pieces of work which have been well done. Work well done makes a man's life of value to his fellow men. And now to have this committee tell me that I have done good work by awarding this medal is a very great comfort to me, and it will sweeten the rest of my life.

As I came from my home in Newark to this meeting tonight I noticed the lights, and I believe that every lamp I saw, from the largest to the smallest, from large street lamps to small automobile lamps, was an incandescent filament. And yet when I was twenty-one years old Mr. Edison had not yet invented the incandescent electric lamp, and we knew only gas, oil and candles and an occasional electric arc lamp. When I worked at Menlo Park I often went home at night on the Pennsylvania Railroad, and the conductors carried lanterns on their arms to enable them to read the tickets.

The Edison Lamp Works were started in Menlo Park in the fall of 1880, so that 1881 was the first complete year of their operation. In 1881 they made 35,000 lamps. Now the General Electric Company makes one thousand lamps every minute of every working day, and the General Electric Company, together with other lamp manufacturers all over the world that work under the patents of the General Electric Company, makes more than three thousand lamps per minute every day.

Three Periods of Development

During these years two great developments have taken place, one affecting the quality of the lamp and one affecting the cost and manufacturing facility. Improvements in quality have been made by changes in the filament, vacuum and other details inside the lamp. I will consider this quality development in three periods:

1. The period of the carbon filament.
2. The short period in which the metallized filament and the tantalum filament held the field.
3. The period of the tungsten filament.

The carbon filament was alone in the field from 1880 to 1905. During this time a great advance was made. The treated filament was developed to its full value, the squirted cellulose filament was introduced, and so was the phosphorus exhaust. These and other minor developments improved the quality of the lamp greatly. Any improvement in lamp quality may be utilized in two ways—the life of the lamp may be kept the same and its efficiency increased, or the efficiency may be kept the same and the life increased.

It has been the policy from the beginning to keep the life constant and utilize all the improvements in increasing the efficiency. So during the carbon-filament period the efficiency increased from 1.68 lumens per watt to 3.4 lumens per watt. In order to compare the relative quality of two lamps one may compare the seventh power of the two efficiency figures, or one may compare the lives of the two lamps at the same efficiency. If this is done, it will be found that the 1905 carbon-filament lamp, if tested at the efficiency of the 1881 lamp, will have a life 139 times as long as the life of the 1881 lamp; so we say the value of the 1905 lamp was 139 times the value of the 1881 lamp.

The metallized carbon filament invented by Dr. Whitney of the research laboratory of the General Electric Company was introduced in 1905, and the result was a lamp which had a value 4.77 times the value of the 1905 carbon-filament lamp. A year or so later the tantalum-filament lamp invented by Von Bolton was introduced, with the result that there became available a lamp having a value 2.71 times that of the metallized carbon-filament lamp.

Era of the Tungsten Filament

Both the metallized carbon-filament and the tantalum-filament lamp promptly gave way and were displaced as a result of the remarkable improvement brought about by the introduction of the tungsten-filament lamp in 1907. This is the lamp which reigns supreme today. Like all other forms of the incandescent lamp, it has been improved and its efficiency increased by the engineering and development work which has been spent upon it, but it is still the tungsten-filament lamp and owes its efficiency and value to the use of tungsten as the filament. Since 1907 the filament has been changed from a squirted filament to the draw-tungsten wire invented by Dr. Coolidge of the research laboratory. The exhaust process has been developed and improved, and tungsten filaments of different crystalline structure have been developed for use in different types of lamps. This work and development include a number of improvements which are inventions in themselves. The efficiency of the 40-watt tantalum-filament vacuum lamp of 1906 was 4.9 lumens per watt. The efficiency of the tungsten-filament vacuum lamp today is 10.3 lumens per watt. Compared on the basis of lives at the same efficiency, the tungsten-filament lamp of 1925 has 180 times the value of the tantalum-filament lamp of 1906.

During the forty-four years of the history of the incandescent lamp its efficiency has improved from the 1.68 lumens per watt of the original carbon-filament lamp of Edison to the 10.3 lumens per watt of the modern vacuum tungsten-filament lamp of today. In other words, the value of the tungsten-filament vacuum lamp of 1925 when compared with the carbon-filament lamp of 1881 is 325,000 times as great.

So far I have considered only the vacuum lamp. The gas-filled lamp of Dr. Langmuir made an enormous improvement, especially in large lamps. During the year in which the gas-filled lamp was introduced we made 500-watt tungsten-filament lamps of both kinds—vacuum and gas-filled. The vacuum lamps gave 8.17

*Edison medalist. Response made in formally accepting the Edison medal at the A. I. E. E. midwinter convention in New York, February 12, 1925.

lumens per watt and the gas-filled lamps gave 14.44 lumens per watt. The gas-filled lamp would last fifty-four times as long as the vacuum lamp at the same efficiency.

The gas-filled lamp completed the triumphs of the incandescent lamp. It has enabled the incandescent lamp to enter the field of very large lamps and special lamps; it has virtually driven the arc lamp out of the market and made street lighting better and cheaper than ever before. Its use is being extended constantly and will continue to be still more extended.

EXHAUSTING THE LAMP

The problem of lamp exhaustion has been with us from the beginning. The chief difficulty in exhausting a lamp is taking care of the moisture which adheres to the surface of the glass. The amount of this moisture is very considerable, and it can be liberated by heating the glass. As the glass is heated hotter and hotter, even up to the softening temperature of the glass, more and more moisture is liberated, so during or immediately before exhaustion the lamp must be heated to a temperature considerably higher than it will attain under any condition of use. In practice we heat the lamp as hot as practicable and to at least 300 deg. C. After the moisture is driven from the glass, the problem is to get rid of it. During the first fifteen years of the history of the lamp the exhausting was done on mercury pumps which would not pump out this water vapor, so it was absorbed by phosphoric anhydride in a glass cup placed to bring the drier as close as possible to the lamp; but even then the absorbing action took place through the exhaust tube, which was of small diameter and about 2½ in. long. This absorption took considerable time, and exhausting an ordinary lamp in this way took a half an hour. The modern way of getting rid of this water vapor and other residual gases is by chemicals. An Italian engineer—Malignani—discovered that phosphorus vaporized in the lamp under proper conditions precipitated all water vapor and all other gases remaining in small quantities in a lamp after it had been exhausted to a vacuum less than one millimeter pressure. He painted the inside of the exhaust tube with red phosphorus and exhausted the lamp on a fast mechanical pump. When the vacuum was under one millimeter the lamp was lighted to high incandescence and a blue glow appeared all through the bulb. The connection with the pump was then closed and the phosphorus heated, driving a lot of phosphorus vapor into the bulb while the blue glow filled the bulb. The blue glow instantly disappeared and a good vacuum resulted. The exhaust tube was then sealed off from the bulb. By this method lamps were exhausted in about one minute, the lamps being thoroughly heated before they were put on the pump. In the present day practice the phosphorus is applied as a coating on the filament. The lamp is exhausted on a highly developed rotary vacuum pump to a pressure less than one-tenth of a millimeter of mercury. The lamps are well heated beforehand, but are not lighted up during exhaustion. After the lamps have been sealed off and based they are lighted up brightly. A blue glow appears in the lamp which immediately disappears, leaving a good vacuum of less than one-thousandth of a millimeter pressure of mercury.

Although we have used this phosphorus exhaust for thirty years, we do not yet fully understand its action. We believe its action is not entirely chemical, because other materials will condense or clean up water vapor, oxygen, hydrogen, nitrogen, CO or CO_2. We believe that a chemical action takes place with oxygen and water vapor and that the products of these combinations are carried to the surface of the glass and held there. We also know that under the condition of ionization indicated by the blue glow gases which do not combine chemically with phosphorus are carried to the glass and held there permanently. These gases may be liberated in the lamp in their original condition if the glass be heated again hot enough to vaporize the phosphorus. We believe that phosphorus has a continuing action during the life of the lamp in case any oxygen or water vapor is liberated in the lamp. We believe also that the phosphorus acts solely to get and keep the vacuum. It acts on gases only. Phosphorus used in this way is called a "getter"—it gets the vacuum—it is used in all vacuum lamps.

ACTION OF THE "GETTER"

There is another kind of "getter" also used in all vacuum lamps, the action of which is to reduce the blackening of the lamp. This getter is usually a halogen compound, such as a fluoride, and it is applied to the filament as a coating. In practice it is mixed with the phosphorus and the mixture is put on the filament. When the lamp is flashed after exhaustion the getter vaporizes and condenses on the bulb, where it remains. During the life of the lamp atoms of tungsten fly from the hot filament to the bulb and slowly blacken the bulb. The getter reduces this blackening very much.

Developments affecting the cost and manufacturing facilities have been going on during the entire history of the lamp. In 1881 no glass-working machinery existed. All glass work was done by skilled glass workers. Today no skilled glass workers are employed in the factory. In the beginning bulbs were blown from glass tubing by skilled labor. Later they were blown directly from the glass furnace by skilled labor. Now they are made by an entirely automatic machine. One of these machines will make more than fifty thousand bulbs in twenty-four hours.

The inside part or stem is also made on an automatic machine. The three glass pieces which compose it are automatically fed to the machine, held in their proper relative positions, and sealed together.

The stem is then put on another automatic machine which inserts the filament supports, after which the filament, which is a very strong tungsten wire, is draped on the supports by hand. Then the two parts, the bulb and the mount, are put in their proper relative positions on the sealing-in machine and the flared end of the stem is sealed in the open neck of the bulb, thus completing the structure of the lamp.

While on the sealing machine the glass bulb and stem are heated very hot, and they are placed on the exhaust machine in this hot condition. The exhaust machine connects the lamp to four pumps, one after another, and these pumps produce a vacuum in the lamp of about one-tenth of a millimeter of mercury. The filament is not lighted during exhaustion. The lamp is automatically sealed off and delivered to the basing machine. After basing the lamp is lighted to high incandescence, the blue glow comes and goes and the lamp is finished.

As a result of the improvements briefly referred to, the number of lamps produced per operator per hour is now 150 times the number produced per operator per hour in 1881.

Testing of High-Tension Cable

Discussion of A. I. E. E. Paper—Tests on Cables of Other Manufacturers Show that Conclusion Originally Arrived at Should Be Modified—Suggestions for Solution of Problem Given

By D. W. ROPER*

Underground Cable Superintendent Commonwealth Edison Company

THE paper by E. S. Lee of the General Electric Company entitled "Testing High-Tension Impregnated-Paper-Insulated Lead-Covered Cable" is the best discussion of the subject of testing high-voltage cable that has ever been presented to the Institute and contains a great amount of interesting information all drawn from the experience of one cable manufacturer. Some of the conclusions which he draws are, therefore, rather limited in their application as they refer solely to the particular type of insulation with which he is familiar. As will appear later in this discussion, there is a wide variation in the characteristics or properties of the insulation made by the different manufacturers. For the purpose of broadening our view and thus improving our perspective, and not for the purpose of making any invidious comparisons between the products of the several manufacturers, I am going to quote some of the results that we have obtained in testing the product of a number of cable manufacturers, in the hope that I may be able to show how some of the conclusions given by Mr. Lee should be modified.

Mr. Lee cites the case of the failure of an experimental length of cable connected to a 110-kv., three-phase overhead line and states that the examination revealed absolutely no discernible cause for the failure.

About one-third of our failures in service result in a similar manner. The author also states that the study of the current-time curves obtained with insulation resistance measurements should be vigorously continued. On this point I thoroughly agree with him and offer him our continued assistance, bespeaking for him the co-operation of other operating engineers who are in a position to assist. The development of additional methods of testing cable should result in the discovery of causes of failure for which no explanation can now be given.

Data taken by Mr. Lee on the variation in insulation resistance of fourteen reels of cable showed that the maximum range was of the order of ten to one. A study of our records shows that in three shipments of similar cable ranging from thirty to sixty lengths the

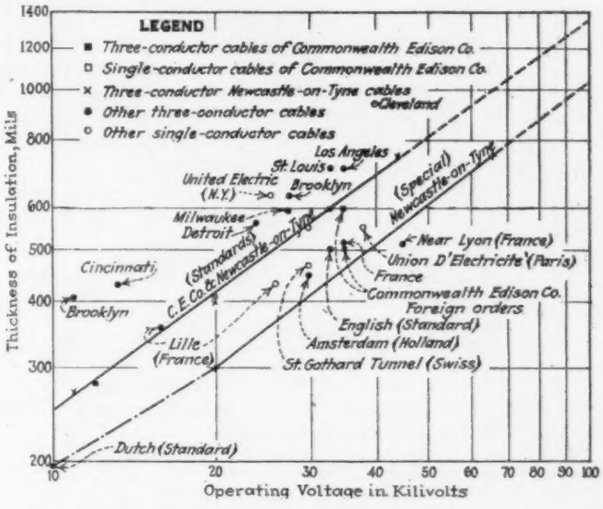


FIG. 1—RELATION BETWEEN THICKNESS OF INSULATION AND OPERATING VOLTAGE

This is based on previously published and private data showing recent practice of Commonwealth Edison Company and a number of American and European companies. The operating voltage given is between conductors for three-conductor cables and between conductor and lead for single-conductor cables and three-conductor Amsterdam cable.

*Discussion presented before the midwinter convention of the A. I. E. E., February 10, 1925.

COMPARISON OF RESULTS OF INSPECTION AND TESTS ON THREE-CONDUCTOR CABLE RATED AT ABOUT 13 KV. AND MADE IN 1924

Item No.	Item	Weight for Best Performance	Weights for Various Manufacturers A	B	C	D	E	F	G
	Mechanical								
1	Wrinkles	4	4.0	3.2	3.0	3.0	4.0	2.8	3.6
2	Creases	4	4.0	3.0	3.6	3.0	3.6	3.2	3.6
3	Tearing in cold bent sample	4	3.2	4.0	3.0	3.6	3.2	3.0	2.9
4	Fillers	4	4.0	3.6	3.4	2.0	3.4	4.0	2.6
5	Impregnation	8	8.0	6.2	8.0	6.2	6.2	4.0	6.2
6	Other conditions*	6	6.0	4.8	6.0	3.8	4.8	3.3	3.9
	Electrical								
7	Range of insulation resistance	5	3.1	2.6	5.0	2.0	3.4	4.5	2.5
8	Increase in power factor† average	5	4.0	5.0	2.3	4.9	3.9	4.8	3.4
9	Increase in power factor, maximum	10	7.9	8.1	4.7	9.0	5.6	10.0	7.1
10	Dielectric loss at 80 deg. C., average	3	0.9	2.2	1.0	3.0	1.0	1.5	1.2
11	Dielectric loss at 80 deg. C., maximum	7	2.1	4.6	3.1	7.0	3.4	3.6	3.4
	Puncture voltage								
12	Hot straight sample, average volts per mil	7	7.0	6.5	6.9	6.8	7.8	6.5	5.4
13	Hot straight sample, minimum volts	11	8.6	7.8	8.4	7.4	11.0	9.3	8.1
14	Cold bent sample, average volts per mil	8	8.0	6.9	6.7	6.7	4.2	3.0	4.1
15	Cold bent sample, minimum volts	14	13.5	14.0	13.1	8.9	10.0	7.2	10.1
	Total weight, mechanical	30	29.2	24.8	27.0	21.6	25.2	20.3	22.8
	Total weight, electrical	70	55.1	57.7	51.2	55.7	50.3	50.4	45.3
	Grand total weight	100	84.3	82.5	78.2	77.3	75.5	70.7	68.1

* "Other conditions" include: (1) twisting of sectors; (2) registered tapes; (3) workmanship in starting and ending tapes; (4) thickness of lead and insulation in routine and deformation tests; (5) over-all diameter; (6) condition of lead sheath.

† Increase in power factor at room temperature between 45 per cent and 215 per cent of rated voltage.

maximum range in insulation resistance was one and six-tenths to one as compared with Mr. Lee's figure of ten to one for fourteen reels. The author thinks that such measurements are of little value as a means of distinguishing between good and poor cable. In view of the data regarding other makes of cable which have been quoted, it appears that the results given by the author indicate that in his factory they have not gained

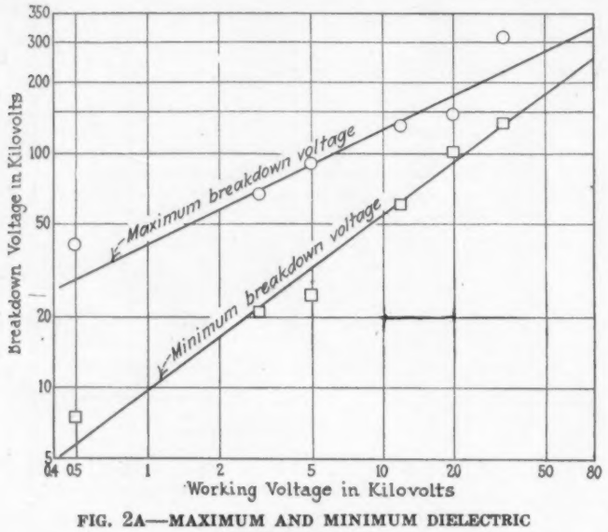


FIG. 2A—MAXIMUM AND MINIMUM DIELECTRIC STRENGTH VALUES

Breakdown voltages of tests on hot straight samples of impregnated-paper-insulated, lead-covered cables made for Commonwealth Edison Company in 1923 and 1924.

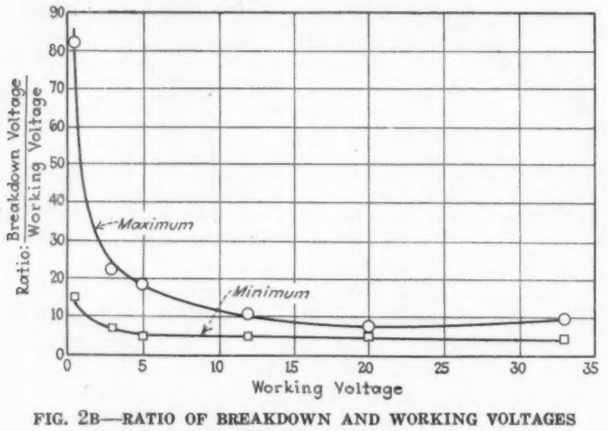


FIG. 2B—RATIO OF BREAKDOWN AND WORKING VOLTAGES TO WORKING VOLTAGE

control of all of the factors which affect the quality of their insulation. It also appears that studies made for the purpose of eliminating the present variations in insulation resistance will result in methods that will bring about an improvement in the product and that there is an even greater chance of such a result than that the studies of current-time curves of insulation resistance will result in the discovery of improved methods of testing.

No methods of testing high-voltage cable will be satisfactory until it is possible to detect and reject at the factory all cable which contains the germ of a failure that will occur shortly after the cable is placed in service, such as the example cited by the author. This requirement, while it may appear somewhat idealistic, becomes more important as the operating voltage of the cable is increased. On a 12-kv. line it may be possible to carry a maximum load of 8,000 kva.; on a 33-kv. line this figure will be about 15,000 kva. or 20,000 kva.; on a 66-kv. single-conductor line the load may be 40,000 kva. or 50,000 kva., and on a 110,000-kv. single-conductor line the maximum load may be 70,000 kva. These figures, which are illustrative and not intended to be strictly accurate, show that the importance of continuous service increases rapidly with the operating voltage.

IMPROVED METHODS OF TESTING NEEDED

The record of a number of recent installations of high-voltage cable made in this country and abroad, as shown in Fig. 1, indicates the general trend of thickness of insulation as related to the operating voltage. This record indicates that the operating voltage is increasing at a faster rate than the thickness of insulation. This means that as the operating voltage increases the dielectric stresses increase, and if the cable is to be as successful in operation as cable of the lower voltages, there must be a continuous improvement in the quality with the increase in the operating voltage. It is therefore quite necessary, as stated by the author at the beginning of his paper, that improvements in cable manufacture should be paralleled by improved methods or additional methods of testing, so that we may be able to distinguish good cable from cable that will prove unsatisfactory in service.

The rainbow that the engineers of some manufacturers, as well as engineers of operating companies, including the writer, have been chasing for a number of years is the search for some single test that will discriminate between good and poor cable. But impregnated-paper insulation is such a complex structure, and as made at different factories has such wide variations in its several properties, that the discovery of any single test that will prove adequate seems to be just as hopeless as the discovery of perpetual motion. Impregnated-paper insulation has a number of different qualities, as set forth by the author, such as insulation resistance, dielectric strength, dielectric loss, etc., and these qualities are so interrelated that it is difficult, or perhaps impossible, to improve the insulation in one particular without having some effect on the other qualities. These several qualities individually have very different values in determining whether the cable will prove successful in service. In Fig. 2 are shown the maximum and minimum dielectric strength values obtained in accordance with A. I. E. E. standards on short lengths of cable for all of the sizes purchased during the last two years by the company with which the writer is connected. All of these cables have met the requirements of the N. E. L. A. specifications and the A. I. E. E. standards. It will be noted that the range in dielectric strength varies from five to one for low-voltage cables to about one and a half to one for 20-kv. single-conductor cable and two and four-tenths to one for 33-kv. cable. It appears fairly evident from these data that the several cable manufacturers place very different weights on the importance of dielectric strength.

In Fig. 3 are a number of curves showing the variation of dielectric loss with temperature which are typical of the product of virtually all the leading cable manufacturers in the world, each one of whom thinks that in this particular feature his cable is entirely satisfactory. With such wide variation in the form of the curves and in the values of the losses at the maximum operating temperatures, it does not appear that all of them can be right.

In a similar manner Fig. 4 shows typical ionization curves; that is, the variation of power factor with voltage. One manufacturer contends that there should be no variation in the power factor between 50 per cent and 150 per cent of normal voltage, while another manufacturer contends with equal force that a variation of 2 per cent over about the same range of voltage is permissible. No one manufacturer makes cable which is the best in all of those qualities described by the author which collectively indicate its excellence, and, in the face of the conflicting statements presented by various cable manufacturers that are equally skillful and reputable, what is the purchaser to do?

CABLES HAVE SHOWN IMPROVEMENT

During recent years improvements in cable manufacture have been so rapid that it is not possible for an operating company to buy cable of several different combinations of the qualities illustrated and then wait for five or ten years to determine from operating experience which of the several varieties is the best before purchasing any more cable. Commercial developments and increases in load compel the operating companies to buy cable every year, and even if they should wait for five or ten years before buying more cable, they would then be told by the manufacturers that such cable was no longer made, owing to their improvements in manufacture, and cable of a different combination of qualities would be offered.

The writer's suggestion for a solution of this problem is given in the accompanying tabulation. In it are listed all of the test requirements given by Mr. Lee. There are also given in the third column, under the heading "Weight for Best Performance," the writer's

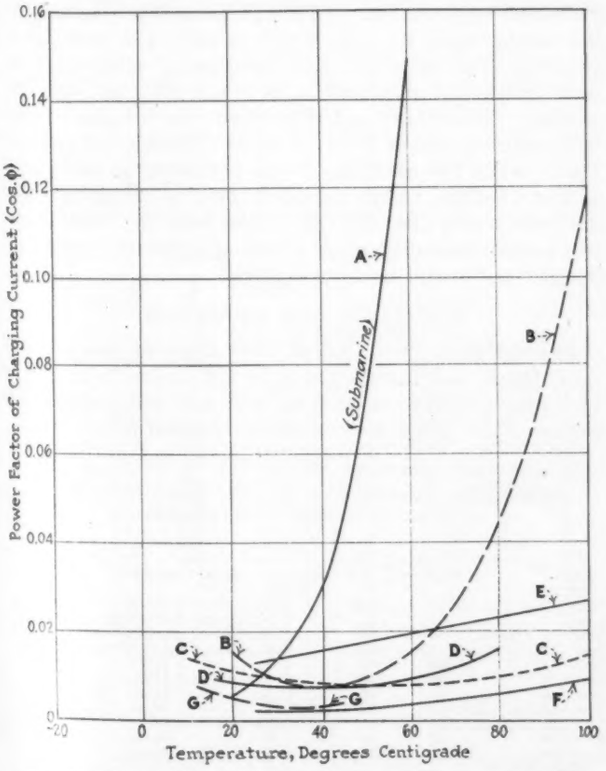


FIG. 3—VARIATION OF POWER FACTOR WITH TEMPERATURE

High-voltage paper-insulated cables made by six manufacturers of five countries. Curves B, C and D are guarantees. Curves A, E, F and G are of test results. All curves are for 60 cycles except A and C, which are for 50 cycles.

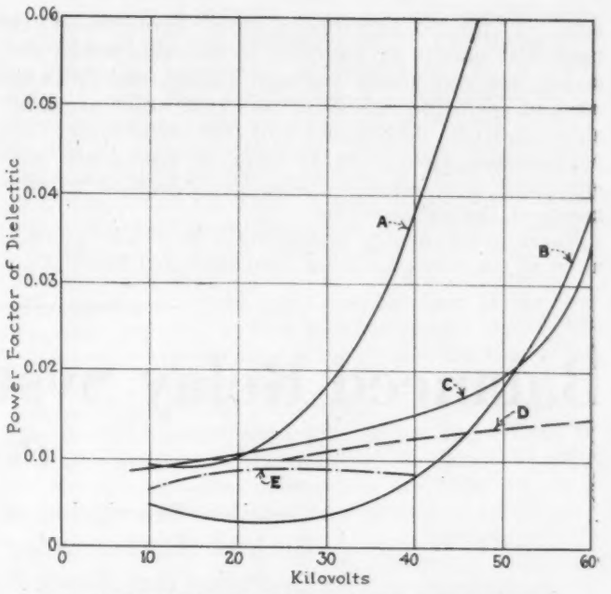


FIG. 4—VARIATION OF POWER FACTOR WITH VOLTAGE

Tests conducted at room temperature on various three-conductor high-tension cables. All are 33-kv. cables except D, which is a 10-kv. cable. All taken from tests for Commonwealth Edison Company except D, which was taken from publication.

judgment as to the relative weight which should be assigned to each of those qualities or properties. As set forth in the table, all of these cables comply with the N. E. L. A. specifications and the A. I. E. E. standards, but it will be noted that they pass the specifications with widely different margins in the various particulars. The cable which gives the best results in the ionization test is not the best in dielectric loss or dielectric strength. As these figures in column "Weight for Best Performance" are the personal opinions of the writer, it is entirely possible that they are all wrong or that the method of calculating the relative performance of the several manufacturers from the test records should be used. A number of similar tables have been calculated, using radically different figures in the column of weights for best performance. These calculations show that changing the figures in this column to any other figures which appear to be within reason makes but slight changes in the relative order of the manufacturers. Such calculations indicate that the general method is correct, but some adjustment of the details may be necessary to secure greater accuracy. It is not pretended that the figures at the foot of the table correctly represent the relative merit of the cables on a percentage basis, but it appears that the table does determine, with reasonable accuracy, their relative order of merit. It should be possible by a study of the test records and the operating records to determine with a fair degree of approximation the proper figures to be used for the weights for best performance, and after this has been done the rating of the cables consists mainly of simple arithmetical calculations from the test records. After such a tentative assignment of weights has been agreed upon by the manufacturers and the operating companies, then the manufacturers have a definite statement of the desired combinations of qualities to guide them in the improvement of their product. This method offers great promise for real improvement in cables.

The operating companies on their part should carefully analyze all of their cable failures, with the assist-

ance of the manufacturers, and agree upon the particular quality or property of the cable whose deficiency was responsible for each failure, and from the mass of operating records of this kind which are available for study modify not only the weights for best performance from time to time in accordance with operating experience, but also the minimum requirements of the specifications.

There is no country in the world in which the engineers of the manufacturing companies and those of the operating companies are so well organized as they are in America through their technical associations, like the A. I. E. E., and the technical committees of their commercial associations, like the N. E. L. A. and the A. E. I. C., to bring about such co-operation in a proper way. If this co-operation can be had, there appears to be no good reason why the American cable manufacturers should not in a few years be leading the world in the manufacture of high-voltage cable, instead of occupying their present subordinate position.

Balanced Relay System for 220-Kv. Lines

Part II

Detailed Description of Necessary Equipment at Each of the Generating Plants and Substations— Operating Experience Has Been Quite Satisfactory

By E. R. STAUFFACHER and F. H. MAYER*

THE general aspects of the application of balanced relays to the 220-kv. Big Creek transmission lines of the Southern California Edison Company were described in last week's issue of the ELECTRICAL WORLD. The following is a detailed discussion describing the equipment at each of the generating plants and substations:

A diagram of connections for the current-balanced relay equipment, together with the automatic flashover field-control equipment at Big Creek No. 1 power house, is contained in Fig. 1. Here two banks of auto-transformers are installed, one on each line, each bank having a capacity of 52,500 kva. Each bank is of sufficient capacity to carry the entire output of the plant. These auto-transformers each have a current transformer in the grounded side of the winding, and each of the current transformers is balanced against its corresponding phase in the other bank of current-balanced relays, which in this case is a type CD relay.

At the time of a flashover on the transmission line the relay contacts will close and the 150-kv. line circuit breakers supplying the faulty line will trip out automatically, thus clearing the first line. In addition, the CD relays are used to clear the trouble due to an unbalanced current on the phase wires, and in order to provide further reliability to the relay system there have been recently added other relays of the same balanced type. These, however, are so constructed that they will operate on a lower value of current. These low-energy relays, as they are called, will operate on an unbalance of ground or residual current and will allow the phase relays to be set high enough to take care of short-circuit conditions between conductors and yet will permit a low setting of the low-energy relays. In this way the relays will function when a small residual current might flow because of a comparatively high-resistance flashover to ground.

The second line will become non-automatic after the first line has cleared, the reason for this being that it would, of course, be dangerous to separate the power houses from the load on a transmission line of such high voltage and length and that there is little to gain by automatically clearing a flashover on the last line between the major source of supply and the load.

It will be noted from Fig. 1 that there is installed in the common wire, or the residuals of the current transformers, an overload type CO relay for each bank of transformers. Any unbalance of current on the transmission line produced by a flashover will cause the current to flow through this relay. In this particular installation this is also the master relay for the automatic flashover field control. This will cause the contacts of the master relay to close, which in turn will operate an auxiliary type M relay. The functioning of the type M relay will cause an alarm to be given both visually and audibly. Simultaneously with the alarm the same relay will cause the relays known as type CR-2800 to function. There being two exciters, it was necessary to have four of the CR-2800 relays installed, two of which operate the two motor-operated rheostats and the remaining two are so connected as to attack the master control of the two automatic field regulators.

EXCESS VOLTAGE PROTECTION

In order to protect against the danger of excess voltages, there was installed a type CV overvoltage relay. This relay attacks the rheostat only and will prevent the voltage from rising above a predetermined point. Over-

RECORD OF OPERATION OF FLASHOVER CONTROL AND BALANCED-RELAY OPERATIONS

Date	Tower Location: Mile	Tower Location: No. of Tower	Relay Operation	
1923				
Sept. 9	124	6th	N.G.; cleared north end only	
Sept. 11	83	...	O.K.; cleared both ends satisfactorily	
Oct. 7	34	5th	N.G.; cleared north end only	
Oct. 7	115	3d	O.K.; cleared both ends satisfactorily	
Oct. 18	40	1st	O.K.	Ditto
Oct. 24	40	1st	O.K.	Ditto
Oct. 26	60	3d	O.K.	Ditto
Nov. 13	53	1st	O.K.	Ditto
Nov. 23	117	1st	O.K.	Ditto
Nov. 25	42	1st	O.K.	Ditto
Dec. 28	121	2d	O.K.	Ditto
1924				
Jan. 30	138	7th	O.K.	Ditto
Feb. 5	121	2d	O.K.	Ditto
Feb. 19	34	5th	O.K.	Ditto
Mar. 31	122	4th	O.K.	Ditto

*Protective engineer and electrical designer Southern California Edison Company, Los Angeles, Cal.

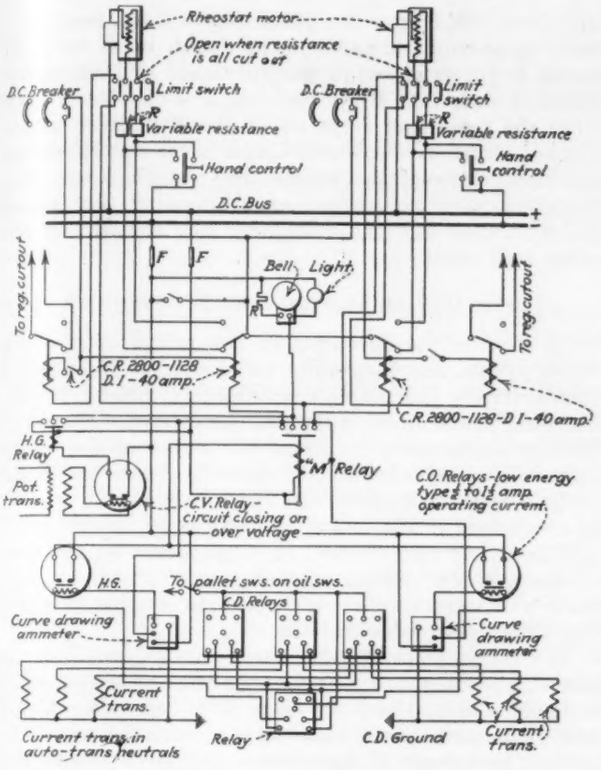


FIG. 1—SCHEMATIC WIRING DIAGRAM OF AUTOMATIC FLASHOVER SUPPRESSOR AND BALANCED-RELAY CONNECTIONS AT BIG CREEK POWER HOUSE NO. 1

voltage relays are installed at all generating plants and substations except at Eagle Rock, where no motor-operated rheostat is available to control the equipment in the substation.

There are knife switches included in all of the secondary relays, which enable the operator or representatives from the maintenance or test departments to render any part of the equipment in the station non-automatic when it is necessary to make tests or to overhaul any part of it.

As Magunden is only a switching station, there being

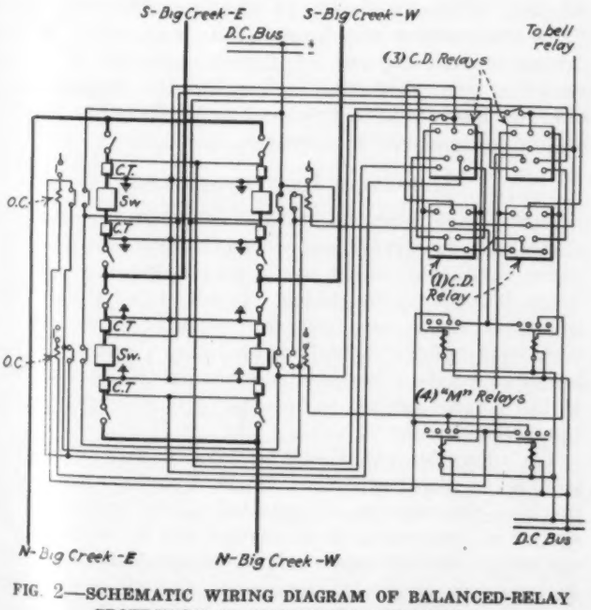


FIG. 2—SCHEMATIC WIRING DIAGRAM OF BALANCED-RELAY PROTECTION AT MAGUNDEN SUBSTATION

no generators, frequency changers or transformers, there is need for balanced relays only. The connections for this relay installation are shown in Fig. 2. The wiring is somewhat complicated in that, because of the rather high cost of 220-kv. oil circuit breakers, the main bus was so designed that only four of these breakers were used in place of five. As a result there was a saving in the cost of oil circuit breakers, but it was necessary to increase the complexity of the tripping circuits to accomplish a result which could have been more easily done had five oil circuit breakers been used.

The operation of the oil circuit breakers at the time of trouble is similar to that at other points; that is, the first set will trip out automatically and the second line will be left non-automatic.

The balanced-relay connections and the automatic flashover field-control equipment at the Eagle Rock receiving substation are shown in Fig. 3. It will be noted that the balanced-relay connections are quite similar to those at Big Creek No. 1. Their method of functioning is also the same in that the first line is balanced and the second line is left non-automatic. Balanced relays are supplied from bushing-type current transformers installed on the 150-kv. switches inside of the substation. It is planned to install additional oil circuit breakers of the outdoor type between the auto-transformers and the substation building and have them handle the duty of clearing flashovers from Eagle Rock. These oil circuit breakers will be of particularly rugged type, capable of handling the most severe short circuit that may be experienced when the ultimate development of the Big Creek project is completed.

The flashover field-control equipment at Eagle Rock is somewhat different from that at the power houses. However, up to and including the type M relay it is identical with that at Big Creek No. 1. At Eagle Rock, instead of the type M relay causing the two CR 2800 relays to operate, which in turn operate the motor-operated rheostats, it causes the two special CR 2800 relays to operate, which attack the master circuits of the two regulators and lock them open. This combination inserts in the condenser field all of the resistance of the field-regulator rheostat over which the regulator plays under normal operation. This resistance is of sufficient value to allow the condenser to remain on the line as an induction motor. As the ground current ceases to flow through the master relay and the condenser comes back to synchronous speed the operator pushes a button, which results in locking out the field regulator and again brings the voltage of the condenser back to normal.

DIRECTIONAL POWER RELAYS FOR FLASHOVER PROTECTION

At the Laguna Bell receiving substation the two 220-kv. lines are protected against interruptions due to flashovers with one three-phase directional power relay known as type IK-105 and three type IA overload induction relays. The contacts of the IA relays are in series with the contacts of the IK-105 relays, which allows for a time setting, if necessary, but prevents tripping on slight current reversals due to line switching.

The two lines leading to Big Creek No. 3 from Big Creek plants Nos. 1, 2 and 8 are automatic at Big Creek No. 3 by means of induction-type overload relays on the second line to trip out. The lines leading to Vestal substation that open south of Big Creek No. 2

are non-automatic for the second line in trouble; therefore, in case of flashover trouble above Big Creek No. 3, power houses Nos. 1, 2 and 8 would be dropped off the system, allowing Big Creek No. 3 to continue rendering service without any unnecessary interruptions. The second line from power houses Nos. 1, 2 and 8 was made non-automatic so that these stations will remain intact as a group. It was considered that this was desirable in

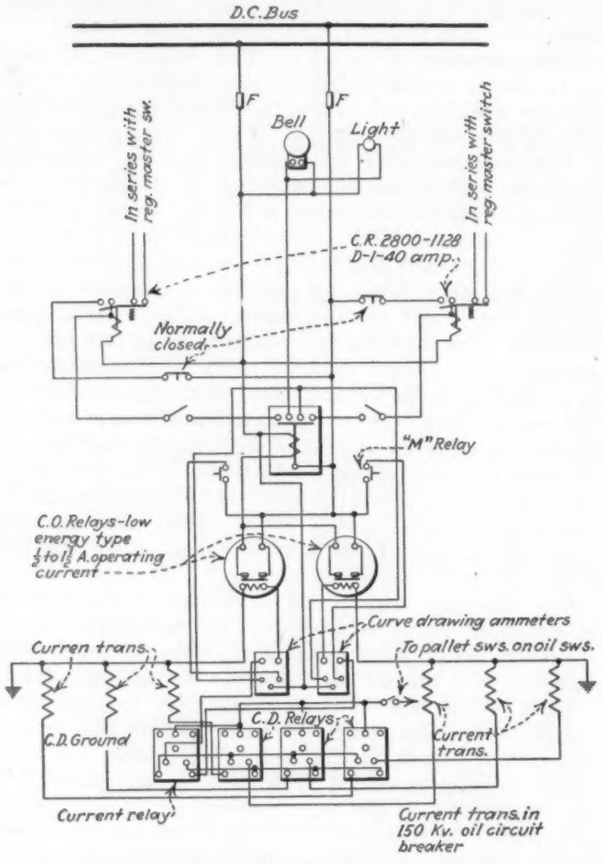


FIG. 3—SCHEMATIC WIRING DIAGRAM OF AUTOMATIC FLASHOVER FIELD CONTROL AND BALANCED-RELAY CONNECTIONS AT EAGLE ROCK SUBSTATION

that it allowed the flashover field-control equipment to lower the voltage of this group of generators in case of trouble on the lines above Big Creek No. 3. This would clear the trouble on this section after the lines were cut loose by means of the overload relays at Big Creek No. 3.

When there is trouble on the line below Big Creek No. 3 the balanced relays will trip out the section of line in trouble before the automatic flashover field-control equipment can come into play. This is accomplished by the introduction of a time element on the master relay which is installed in the secondaries of the current transformers and in the grounded neutral of the power transformers.

As an additional precaution the generator-field regulator (cut-out) is designed not to function until the motor operating the rheostat has actually begun to cut in the resistance. When there is trouble on the second line the automatic flashover field control of all of the generators and condensers comes into play to restrict trouble.

The automatic features on the second line leading into Big Creek No. 3 from the plants above it can readily be made non-automatic and will, no doubt, be so operated except at times when the load furnished by these upper plants is such that Big Creek No. 3 is capable of handling the total load from all of the Big Creek plants without excessive overload. Under these conditions the overload relays of the second line can be placed into operation with no danger of overloading Big Creek No. 3 in case this one remaining line should trip out above that plant.

Operation of System Very Satisfactory

Up to date the operation of the relays on the Big Creek system has been quite satisfactory. It is only a comparatively short time since the total 220-kv. system has been placed under automatic protection. There has been no opportunity to study the action of the transmission line in automatically clearing flashovers in the section south of Magunden. There have been a number of operations in the two sections from Big Creek No. 3 to Vestal and from Vestal to Magunden. At the time of the greater number of these operations there have been no interruptions whatsoever to service over the Big Creek transmission lines.

The relays were first set for a current unbalance of 350 amp., which means that at the time of flashovers an unbalance of 350 amp. or more must take place before the relay contacts will close and trip out the proper oil circuit breakers. It was found that in two cases this setting was too high for the southern end of the section in trouble; that is, there was not sufficient energy suplied from the Los Angeles end toward Big Creek to cause the unbalance of 350 amp. The relays caused the proper oil circuit breakers to trip out at the northern end in each case, but in two cases no oil circuit breakers tripped out at the southern end of the section in trouble. After the second occurrence of this sort the relay settings were lowered so that 300 amp. unbalance was all that was necessary to cause the relay contacts to close, and since that time the operations have been satisfactory, clearing the trouble in from two to five seconds.

The operation of flashover-control balanced relays in the two sections of line which have been in service since August, 1923, is shown in the accompanying table. From this table it may be seen that there were thirteen perfect operations out of fifteen possibilities. This record is very good considering that the installation is new and had not been tried out or perfected completely before being placed in operation.

Operation Justifies Expense

There have been no flashovers when the balanced relays were in service, nor where the line was operating under conditions which would permit putting balanced relays into operation, that is, operating in parallel after balanced relays were put into service in the section between Magunden and Laguna Bell. Consequently, at present no data are available covering the performance of the balanced-relay equipment in this section of the 220-kv. system.

The operation of balanced relays to date in clearing trouble on this important trunk line has more than justified the expense of installation and upkeep in the saving of interruptions to service and in keeping at a minimum the damage to the transmission-line conductors, corona shields, insulators and other apparatus on the lines.

Oliver Heaviside, F.R.S.*

Memorial Sketch of the English Mathematical Genius Whose Writings So Greatly Influenced Contemporaries Engaged Like Him in Electrical Research—Was He Unfairly Neglected?—His Additions to the Vocabulary of Science

By SIR OLIVER LODGE

OCCASIONALLY a remarkable genius arises, we know not how nor whence. Such a one runs the risk of being misunderstood and neglected in his lifetime—partly perhaps because he has not gone through the ordinary processes of education, and has therefore not attracted the attention of his contemporaries in the regular way, and partly because his insight may be of an unorthodox and exceptional type and his utterances personal and peculiar in style. He is also apt to be more or less in advance of his time, so that it is sometimes left to posterity to discover the brilliance and notable character of his achievement. Such a man was Waterston, who evolved the kinetic theory of gases years before the scientific world was ready to receive it, so that his communication to the Royal Society on the subject was turned down by the referees; and we are now told that among Waterston's papers will be found other striking anticipations of the course of scientific progress, though they have not as yet been made public.

Such a man again was Oliver Heaviside, a mathematical genius of exceptional ability, who flooded the columns of the *Electrician* with remarkable but ill-understood papers, the value of which was, however, recognized some time before his death (partly by Lord Kelvin, partly by FitzGerald, Dr. G. F. C. Searle and others), but which for all practical purposes had been rejected by the telegraphic authorities of his time and regarded as nonsense by no less a personality than Sir William Henry Preece, that genial orator for many years engineer in chief to the telegraphic department of the British Post Office. Indeed, I was told that a paper by his brother, A. W. Heaviside of Newcastle-on-Tyne, was rejected by the Society of Telegraph Engineers because it embodied in more practical form the results of his brother's mathematical researches. There is no doubt that Oliver Heaviside felt this neglect and contumely very keenly, and he gave expression to it in humorous and sarcastic fashion on many occasions.

HEAVISIDE'S UNUSUAL PERSONALITY

All this is now ancient history; but reference to it cannot properly be omitted, for it loomed large in Heaviside's mind and saturates many of his lighter papers. Besides, when serious mistakes are made it is only just that for a time they should be remembered. Recognition, though tardy, came at length—perhaps too late to be altogether consoling. The Royal Society made him a fellow. The Institution of Electrical Engineers awarded him its most distinguished medal, and its president took the trouble to convey it personally to him at his solitary home in the depths of the country.

Part of the difficulty of recognizing Heaviside's achievements lay no doubt in his own personality. He was of very retiring disposition, with no social gifts. He lived alone in what appeared to be a state of considerable poverty, cooking his own food, waiting on himself and suffering from indifferent health. He was visited from time to time by admirers of his genius in his dismal lodgings at Kentish Town; but as soon as he began to be recognized he fled to Devonshire and thence emerged no more—never, so far as I know, attending the Royal Society or the Electrical Engineers, or coming to hear the congratulations which might—late in life—have been showered on him, and living to the end the life of a recluse.

A VOLUMINOUS CORRESPONDENT

He was a voluminous correspondent however, and both FitzGerald and I received innumerable letters from his pen. Dr. Searle also must have received many and probably continued to know him personally better than any one else. He it is who would be able to tell us more about Heaviside's life and education. How he acquired his mathematical knowledge I do not know; I hope that Dr. Searle does and will tell us. But the outcome of his singular mind is embodied in several volumes of "Electrical Papers" (published by Macmillan) and other volumes on "Electromagnetic Theory" (published by the *Electrician*). A reproduction of these last, in three volumes, with the same title, has been recently issued by Benn Brothers (now Ernest Benn, Ltd.).

The fact that these early papers were accepted (I presume paid for) and published by the *Electrician*, for many years, redounds greatly to the credit of that organ; for there could have been but few of its readers who really understood them. By the majority they must have been regarded with more or less awe, perhaps with some suspicion, but with certainly less than adequate attention.

Heaviside had, however, a peculiar vein of humor, and sometimes his writings amused even though they did not edify. He had a wonderful instinct for grappling with the difficulties of a subject and giving it symbolic expression. Probably no one in his time had an equal grasp of the present and future outcome of Maxwell's theory. He expressed the generation of electric waves in his own style; he treated of the motion of electric charges at different velocities, including those which equaled or even hypothetically surpassed the velocity of light. Everything relating to electrical induction, and the energy of electric currents, and the forces and fluxes of energy in the electromagnetic field, the self-induction of wires and the generation of waves, was elaborately worked out in these early papers. He invented a special system of vectorial algebra with which to deal with them. His mathematics often aroused the admiration of John Perry and other com-

*Oliver Heaviside died in Devonshire, England, on February 3, 1925. His exact age appears to be in doubt. A press dispatch gives it as seventy years; Sir Oliver Lodge in a notation accompanying this memoir makes it seventy-four; B. A. Behrend, in the article following this, puts it at seventy-seven.

petent judges. And the three volumes on "Electromagnetic Theory" may be taken as a summary of his matured views on these subjects.

It seems probable that the science of the ether will make more use of his methods and results than it has at present done, though the peculiarity of his modes of expression rather alienated for a time, and perhaps even to this day, the majority of Cambridge mathematicians; for, though there is much originality, there is little orthodoxy in his manner of presentation.

THEORY OF CABLE SIGNALING

The chief subject on which his fame rests at present, the subject also which at the time aroused rather bitter controversy, was his development of the theory of cable signaling. This theory was, as all the world knows, begun by Lord Kelvin. It may be truly said that Lord Kelvin's theory of the propagation of pulses along cables, taking into full consideration their resistance and their capacity, rendered the Atlantic cable of 1865 and 1866 possible, and it may be said also that it was neglect of that theory which slaughtered the first cable in 1858. Lord Kelvin's theory, however, was incomplete; it proceeded on the analogy of conduction of heat; it applied Fourier's analysis of heat conduction to the electrical case, and the results, though most helpful, indeed invaluable, were by no means the last word on the subject. Self-induction, though doubtless partially understood by Lord Kelvin (he called it electrodynamic capacity), was not introduced into his theory; it was probably considered a negligible factor for a long, straight wire. Heaviside recast and remodeled the theory in the most general form; he invented the terms "inductance" and "capacitance," "reactance," "permeance," "permittance" and the like, on the lines of the term "resistance"; and some of these terms have come to stay. He showed that the propagation of signals along wires was in all essential respects identical with the laws of propagation of electric waves in free space. So that when I had the pleasure of detecting electric waves along wires, in or about 1888, at the same time as Hertz detected them in free space, Heaviside hailed both observations as practically one and the same—though there is no doubt that Hertz's investigations eclipsed mine altogether, in thoroughness as well as in practical results.

The theory of the transmission of waves along free aërial wires is simple enough. The equations are much the same as for waves anywhere else; they are given in my *Philosophic Magazine* paper for August, 1888, at the end of a disquisition on lightning conductors. But Heaviside did not stop at waves along aërial wires; he applied the theory to impulses along cables, where the combination of capacity and resistance exercised its deleterious effect and constituted the great difficulty in efficient signaling. He showed that by taking self-induction into account the results could be much more accurately expressed, and, further, that self-induction was not the hindrance or bugbear which Sir William Preece thought it was, but that it was the most essential help. And, indeed, without inductance it is difficult to see now how any transmission theory could be satisfactory. Heat has no rate of propagation, it is merely diffusion; and Lord Kelvin's theory of cable signaling was entirely on diffusion lines. The waves, as it were, soaked through, and the time of arrival was quite indefinite; it depended merely on how sensitive the instrument could be. If you had to signal by heat, along a rod of copper, to a thermometer at one end, by applying to the other end first a flame and then a block of ice, alternately, so that the distant thermometer could experience pulses of temperature and respond to the signals (which in imagination might be dots and dashes), no rate of propagation could be specified. An infinitely sensitive thermometer would feel the influence at once; any practicable thermometer would feel it after considerable delay. But the delay could be reduced by making the thermometer still more sensitive, and that is what Lord Kelvin did. His mirror galvanometer and siphon-recorder were instruments far more sensitive than any of their predecessors, and accordingly the very beginnings of diffusion were felt, and could be stopped, before they had accumulated, by an opposition pulse. That was, and to some extent still is, the system of cable signaling.

EFFECT OF INDUCTANCE

But when inductance is taken into account, it is seen that there is a definite velocity involved, viz., the velocity of light. No instrument could respond instantaneously, even if indefinitely sensitive. True waves are passing along the cable, though greatly modified by the distortional effect of diffusion, which has the effect of transmitting waves at different paces and smoothing out sharp signals, after the same sort of fashion as a coach spring smooths out the bumps and irregularities of a road. Such smoothing-out is to some extent tolerable when dots and dashes, and especially when right and left deflections, are used. A dash is not suitable for transmission, it lasts too long; but right and left deflections, that is positive and negative signals, may be quite brief—the briefer the better, for then there is nothing to accumulate; the positive pulse is curbed by the immediately following negative pulse. All this was applied by Fleeming Jenkin and other telegraphic experts; but no one contemplated the possibility of telephonic speech through a long cable, even after the telephone had been invented. The smoothing out of consonants would reduce them to nonsense, and on Lord Kelvin's theory speech would be unintelligible and impossible of transmission on any cable longer than, say, that across the Irish Sea.

But Heaviside's theory modified all that; he showed that the effect of inductance was to add momentum to the signals, to give them a real speed, to wipe out much of the deleterious effect of capacity, and that if only sufficient inductance could be employed, signals could be transmitted even along a cable of Atlantic length without distortion. He gave, in fact, the theory of the distortionless cable.

He showed also that a certain amount of leakage, lateral escape of electricity, would improve the signals. It would weaken them, of course, but the attenuation might be more than compensated by the absence of distortion.

Put into words, by way of exposition of one aspect of the theory, one may say that for the transmission of true waves—not diffusion waves like heat, but waves like light, waves such as exist in free ether, and approximately along an aërial line—the electric and the magnetic energies are required to be equals. If one overpower the other, we have distortion, varying rates of transmission, or no rate of transmission at all, nothing but diffusion if the overpowering is excessive. In Kelvin's theory it was excessive, because there the inductance was considered zero; that is to say, the

magnetic field was neglected and the electric field alone was taken into account. Heaviside pointed out that the magnetic field was really doing the work, though greatly overpowered by the electric, especially in cables of large capacity. By adding self-inductance magnetic energy could be increased and made more equal to the electric energy. By leakage the overplus of electric energy could be still further reduced, though less economically. If the two energies could be made quite equal, we should have true distortionless waves, with every feature of the signal reproduced at the far end, subject to nothing but attenuation.

Such a state of things can only be approximated in practice. Silvanus Thompson advocated the construction of cables with added inductances so as to carry out into practice Heaviside's views; and every one knows that Professor Pupin, in America, succeeded in influencing capitalists to make such cables, and they were found to have just the properties predicted for them. Moreover, in America successful enterprise has gone further. They really have long-distance telephony there (they say that we have not got any long distance, and therefore have not attended to it so fully); they applied extra inductance to their land lines. And in that way I am told that the American Telephone & Telegraph Company, by applying extra inductance at regular intervals along its extensive continual lines, found it possible to transmit clear and distinct telephonic speech from New York to California and further.

I am now trespassing on subjects concerning which practical experts are more fully informed than myself. But I have said enough to indicate that these interesting and extensive developments (of which we have not as yet by any means heard the last) owe their origin and inception to the genius and perspicacity of the subject of this memoir. That he failed to derive any pecuniary benefit (at least as far as I know) is to be lamented; but under the present system of scientific recognition, or non-recognition, it was probably inevitable. It was not an easy matter to help Heaviside peculiarily. I believe that FitzGerald, and probably others, tried once or twice; but he had a pride which discouraged such attempts. A government pension he was ultimately prevailed on to accept, provided it was so put as to recognize his work for science, so as to remove from it anything of an eleemosynary character in his opinion.

I do not think the man was unhappy, though at one time he was rather embittered by the misunderstanding and hostility of those in authority—an attitude which a genial man like Sir William Preece would have been the first to lament had he been better informed. Heaviside lived an independent, self-contained life, and no doubt his insight into nature (whether recognized by his contemporaries or not) must have given him moments of sincere pleasure. The least we can do now is to recognize his genius and wish that it had been earlier recognized and more widely known.

Career of Oliver Heaviside

An Appreciation of His Character and Genius by One of the Few Who Knew Him and Knew His Point of View—His Timidity and Hermitic Habits—A Glance at His Writings

By B. A. BEHREND

OLIVER HEAVISIDE is dead. Let there be silence in the telephone! What a strange life has closed! A great tragic drama ends. Who was he? What has he done? Why did he die in poverty? A ward of his people's government, living on a pension of $800 a year. Thus has ended a great life, a benefactor of mankind, not a "king maker" like the great Warwick, but a maker of industrial magnates, creator of billions. Of whom are we talking? asks the multitude. It is the genius of the science of the telephone who has passed away in his seventy-eighth year, a recluse, alone, without servants, in poverty, at his neglected house and garden, at Torquay, England. Let there be silence in the telephone! Oliver Heaviside has died.

Some few of us knew him; some few chosen ones among us received his letters, the outpourings of a great and brilliant genius and soul, without the aggressive qualities of the beast of the jungle, without the powers and gift of self-protection. Generously pouring out his knowledge to the mean in heart and intellect, seeking no protection of the law for his ideas, but trusting, trusting in vain, to the nobleness in man, the majesty of soul in a generation which cannot see and does not hear the prophet.

He offended the mighty by his honesty and frankness. He offended his publishers by his satire and irony. His books did not sell. His publishers informed him that storage space was too valuable and that the useless volumes must be made into paper. They were destroyed a generation ago. These two rare volumes, which the Macmillans destroyed, now sell, if at all obtainable, at $50 a volume. The writer of this article, at the caprice of fate, owns Sir William Preece's copy—Sir William whom the great dead taunted for his ignorance of the great theory of the telephone. And Oliver Heaviside recognized no wooden authority, he could not be silenced. He was not worldly wise, no "practician," a term he liked and applied often to the present writer in his private letters. The Bourbons of the new industry took their revenge. Like Haman, in the Book of Esther, they coveted worship, and, like Mordecai, Heaviside refused it. That is why they hanged him on the high gibbet of poverty.

Honorary Member of A. I. E. E.

The American Institute of Electrical Engineers, after much wrangling, elected him an honorary member. Silvanus P. Thompson, one of the two British honorary members, had just died. Heaviside spurned the honor. It took endless effort to make him acquiesce. The letters written during that episode to the present chronicler are delightful and touching. What outburst of

mental agony they breathe! One learns to feel Carlyle's contempt of the human breed, or Tennyson's exclamation, "However we brave it out, we men are a little breed."

A Timid Satirist

It takes a realization of the great truth of Freudian psychology to comprehend the drama of Heaviside. He was so great, in the words of Sir Oliver Lodge, so "powerful a mathematician and physicist," that he stirred the "inferiority complex" of his contemporaries. And, unlike such men as Kelvin, he was too timid and retiring to force his envious imitators to recognize his work and his priority.

Heaviside was self-educated. This aroused the "inferiority complex" of the established and self-constituted teachers and censors of mathematical physics. He had no business to be a great and powerful mathematician. He answered his detractors in satire and irony. Yet the Royal Society took his papers and made him an F. R. S.

All nations honored him, European universities bestowed their honorary degrees upon him, and at last even the American Academy of Arts and Sciences and the American Institute of Electrical Engineers made him an honorary member. He never appeared in public. Few ever saw him. "England," in Prof. Alexander Russell's words to the writer, "does not know how to treat a hermit."

In the midst of the war his housekeeper lost her mind. He lived on alone without care, seventy years old at the time.

He began publishing papers in the *Philosophical Magazine* on electrical matters in 1885. He chose the theory of the telegraph and Maxwell's electromagnetic theory. Then came the great experimental confirmation by Hertz of Maxwell's work. Then came the mechanical development of the telephone and the difficulties of preserving speech without distortion over longer and ever longer distances. As William Thomson, Lord Kelvin of Largs, had solved the electrostatic problem of the submarine cable, so Oliver Heaviside solved the theory of the telephone cable by discovering and describing the "distortionless circuit."

Books on Which Fame Rests

Professor Boltzman called Maxwell's "Electricity and Magnetism" a grand symphony, and well might Heaviside's brilliant solution of the partial differential equation of the transmission of electric "impulses" along wires or cables be likened to a magnificent musical harmony. The beauty and symmetry of the solution was rivaled only by his clear description of the practical application of the theory to long-distance telephony. All this was done in 1893 and before that time. Few understood him, not so much because of obscurity of diction as because he was away ahead of the times. Ten years later his work was revived by others without any more than passing reference to his fundamental papers.

Heaviside's work is recorded in his published papers. There are two sets of these papers. The first, comprising the labors of 1872 to 1892, entitled "Electrical Papers," in two volumes, published by Macmillan & Company in 1892. The second set, comprising his serial articles in the London *Electrician*, republished in three volumes under the title of "Electromagnetic Theory," beginning in 1891 and ending in 1912. The third and last volume contains a reprint of his delightful article in the tenth edition of the Encyclopædia Britannica, published in 1902, on the "Theory of Electric Telegraphy." It contains two references which will be understood by those who know the history of the times. "The insertion of inductance coils at regular intervals, say one per mile . . . The action of the coils is similar to that of small detached loads placed upon a string to give it inertia and enable it to carry waves farther. If we wish to imitate a curve containing bends of various sizes by means of dots, it is obviously necessary to have several dots in every bend. So, in the substitution of detached inductances for uniform inductance, we need to have several coils in every bend of the electrical wave."

This statement was a bare repetition of the one occurring in his historic paper of November 17, 1893, beginning, "Another indirect way is this: "Instead of trying to get large, uniformly spread inductance, try to get a large average inductance. Or combine the two and have large distributed inductance together with inductance in isolated lumps. This means the insertion of inductance coils at intervals in the main circuit. . . . This means using coils of low resistance and the largest possible time constants."

Gibes at a Contemporary

His Encyclopædia Britannica article closes with this reference: "The above radiational theory of telegraphy, founded upon Maxwell's theory of light, has been proved in all essential points and in various details by important experiments of Hughes, Lodge, Hertz and others, to say nothing of long-distance telephony in America or the more recent spherical telegraphy. But quite different views have been maintained by the British official electricians, under the guidance of Mr. (now Sir) W. H. Preece. It is only fair to put on record here his leading articles of faith. The information is derived from his papers. Self-induction is harmful to telephony and is to be avoided and minimized. . . ."

No wonder officialdom, always keenly aware of its ignorance, resented these gibes, made in such important publications as the Encyclopædia Britannica, and, lacking a sense of proportion and humor, retaliated by ignoring him and his work.

It is impossible to give a condensed summary of Heaviside's papers. They may be grouped as papers on the telegraph, the location of faults, general theory, Maxwell's electromagnetic theory, the creation of rational units eliminating the "4π" factor, and thus "rationalizing" the fundamental equations; the development of a system of vector algebra best adapted to the electrical theory; the solution of the fundamental partial differential equations, wherever possible in the conventional way and, where this is impossible, by means of divergent series; the theory of waves from moving sources as in the case of electrons; the theory of spherical and cylindrical waves and the "Heaviside" layer.

Some Interesting Quotations

A few quotations from Heaviside's papers may interest the present-day reader. Thus, in the preface to "Electrical Papers," he says:

"As regards the question, 'Will it pay?' little need be said. For, however absurd it may seem, I do in all seriousness hereby declare that I am animated mainly

by philanthropic motives. I desire to do good to my fellow-creatures, even to 'Cui bonos.' "

Elsewhere, six years later, he says, speaking of plotting diagrams, like Maxwell's, to illustrate the solutions of his equations:

"It should be a labor of love, of course; for although, if done thoroughly, there would be enough to make a book, it would not pay, and the most eminent publishers will not keep a book in stock if it does not pay, even though it be a book that is well recognized to be a valuable work, and perhaps to a great extent the maker of other works of a more sellable nature. Storage room is too valuable."

Illustrating his feeling toward the rigorous school of Cambridge mathematics, see what he says:

"Whether good mathematicians, when they die, go to Cambridge, I do not know."

On the modern tendency to get lost among mathematical equations, he remarks:

"But it is far worse in the more modern dynamics, with ignoration of co-ordinates, and modified Lagrangean functions. Dynamics as visible to the naked eye seems to disappear altogether sometimes, leaving nothing but complicated algebra."

"What I always regard as *the* fundamental principle of dynamics is Newton's celebrated Third Law. If that is not true, the result is Chaos."

"I have observed repeatedly that young to-be physicists, when they leave college, are full of generalized co-ordinates, and the theory of functions, and unnatural spaces, and rigor, but when they become thoroughly immersed in real physics, even though mathematical, a lot of learning referred to fades away. Is Cambridge to blame? Perhaps not. It may be my fault."

It appears from these quotations that Heaviside's papers are not dull reading. They are interspersed with the most delightful bits of humor, sage remarks, retorts to critics, pin pricks to the hacks and Bourbons of science, but devoid of bitterness. This latter appeared in later life and, notably, in private correspondence.

His Lonely End

The war had brought on rapidly rising prices peculiarly hard to bear by the older people. It had dissipated to the four winds domestic servants of any kind, and it had put into the places of the wise the men of the jungle. Delicate and sensitive, Heaviside suffered, at first inconvenience, later real want. His old housekeeper, as he wrote the present chronicler, became "mad" and had to be put away. He lived on alone. He saw reared on his work and genius an industrial and economic edifice of enormous proportions, and he had no share in the rewards and little in the fame. Bitterness entered his heart. He was too proud to accept financial aid or gifts; he preferred to sink into night and neglect alone. His fate was that of which the preacher tells us in "Ecclesiastes":

"There was a little city, and few men within it; and there came a great king against it and besieged it and built bulwarks against it:

"Now, there was found in it a poor wise man, and he by his wisdom delivered the city; yet no man remembered that same poor man."

"Who's Who" for Great Britain reports laconically:

HEAVISIDE, OLIVER, F.R.S.; Hon. Mem. Lit. Phil. Soc., Manchester. Address: Homefield, Lower Warberry, Torquay.

Letters from Our Readers

Effect of the Drought on Southern California Load Curve

To the Editor of the ELECTRICAL WORLD:

In the article entitled "Battling with a Power Shortage," which R. H. Ballard of the Southern California Edison Company supplied to the ELECTRICAL WORLD for January 10, a load curve appears on page 88 (Fig. 2) showing kilowatt-hours per day in 1923 and 1924 with particular reference to the effect of curtailment on the 1924 curve. There is an obvious reversal in the legend on the diagram. The dotted line, of course, represents 1924 and the solid line 1923, and not vice versa.

F. B. LEWIS,
Assistant General Manager.
Southern California Edison Company,
Los Angeles, Cal.

Pressure-Creosoted Poles and Avoidance of Expense for Inspection

To the Editor of the ELECTRICAL WORLD:

On page 1313 of your December 20 issue appeared a paper, "Systematic Inspection of Pole Lines," presented by L. I. Bates at the annual convention of the Empire State Gas and Electric Association. Mr. Bates has evidently gone into this matter very thoroughly, and it is believed that such an elaborate and costly inspection is entirely justified in the case of untreated poles and those only superficially treated. Much of this expense, however, and the additional expense of keeping the proper inspection records would be eliminated if pressure-creosoted poles were originally installed. To install untreated or superficially treated poles in a line is to invite frequent costly inspections, repairs and replacements. Creosoted pine poles in lines in sections of the country where climatic conditions favor decay do not require frequent inspections. In fact, experience has shown that untreated poles or those not properly treated would have had to be replaced entirely because of failure from decay before the need for inspection of a pressure-creosoted pine-pole line presented itself. Pressure-creosoted poles can be expected to last thirty-five or more years. There appears to be no justification for the construction which necessitates costly inspections of the character described in this article.

P. R. HICKS,
Secretary-Manager.
Service Bureau, American Wood Preservers' Association,
Chicago, Ill.

Commends the "Electrical World" for Printing Both Sides

To the Editor of the ELECTRICAL WORLD:

Your news article on "Prominent Men Debate Public Ownership" has been carefully noted, and I wish to say that you have, very properly, departed from the mistaken policy of many newspapers by printing some of both sides of the argument. I saw an account of that debate in two—if not three—New York daily newspapers, and each one of them published only something said by one side. Regardless of what one's attitude toward a subject is, if the subject is a debatable one and of sufficient news value to be mentioned, then it would seem that it is only fair to outline the arguments of both sides. I was delighted to see this done by the ELECTRICAL WORLD.

WM. BENJAMIN WEST.
New York, N. Y.

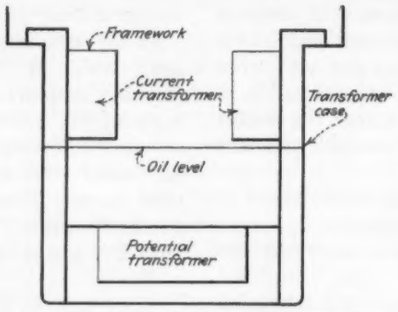
Central Station and Industrial Practice

Adapting Instrument Transformers to Outdoor Use

BY KARL BAUSMAN
Supervisor of Meter Department,
Dayton (Ohio) Power & Light Company

HAVING a number of installations which require outdoor metering equipment involving current and potential transformers, and not desiring to purchase outdoor instrument transformers for voltages up to 6,600, the Dayton Power & Light Company has recently been housing ordinary indoor current and potential transformers in cases which will protect them from the weather. The meter and test block are placed in a separate box, also serving as protection against the weather. If conditions permit the meter to be housed in one of the buildings served, the secondary wiring is run in conduit into the building and terminated in a steel meter inclosure.

The structure used for housing meter transformers for voltages of 2,200 to 6,600 is most interesting. A 50-kva., three-phase transformer case is used for the inclosure. The potential transformers are mounted in the bottom of the case and immersed in oil, while the current transformers are mounted above the oil in the top of the case, the connections on the high-voltage side being made up of suitably insulated cable. The transformers are attached to a simple iron framework hung from and bolted to the ledge at the top of the transformer case. The outlets normally provided in the



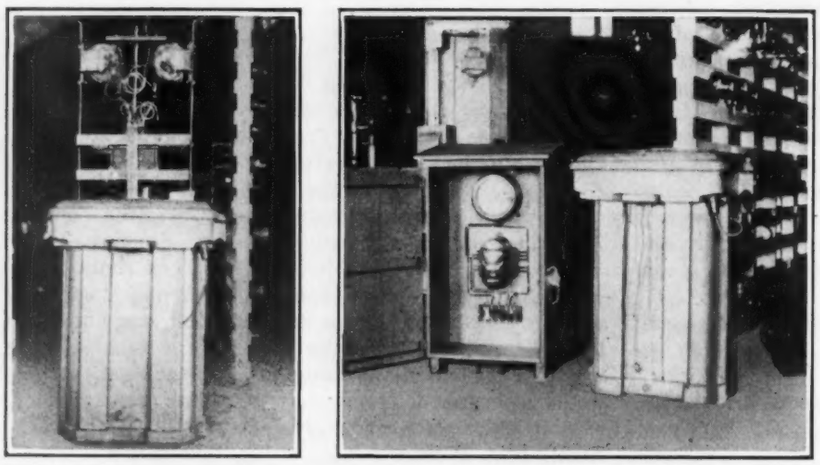
ARRANGEMENT OF CURRENT AND POTENTIAL TRANSFORMERS

transformer case provide egress for the primary and secondary leads of the instrument transformers. The primary leads are supported on standard insulators mounted on the side of the case, which also serve as a support for lightning protection apparatus.

For the secondary leads from the transformers colored cable is used to permit identification, a standard color scheme being adopted. For the potential transformer leads white, green and black cables are used, the latter being the common lead. For the current transformers yellow, red and blue cables are used, the latter being the common lead. The white and red cables are corresponding pairs and prevent wrong connections of the meter.

From the transformer case to the box containing the test block and meter the secondary leads of the transformer are carried through 1-in. conduit.

This arrangement is very flexible inasmuch as stock transformers are used. By the plan any capacity is immediately available for service or replacement in the event of damage by storm or conditions of load.



TRANSFORMER CASES USED FOR OUTDOOR METERING SERVICE

Selection of Central-Station Auxiliaries

THE determination of the most desirable drives for boiler and turbine-room auxiliaries requires a very careful consideration of the effect on the plant as a whole of interruptions in operation, comparative running losses and starting up after an interruption, according to G. G. Bell, manager power generation West Penn Power Company, Pittsburgh, who expressed this view before the Chicago Section, American Society of Mechanical Engineers, recently. Although one station under consideration is expected to drive all auxiliaries with turbines with equal or greater economy than by bleeding steam from the prime movers, the speaker was in favor of motor drive (alternating-current) for most auxiliaries, it being declared that motor drive is liked better by most operators, requires less maintenance, no piping, no gears and no trouble with high-pressure steam.

Among the sources of alternating-current auxiliary power, Mr. Bell referred particularly to four types: (1) Main bus; (2) alternating-current house generators driving essential auxiliaries; (3) alternating-current house generators driving a small percentage of auxiliaries or none at all normally, but providing power in cases of emergency; (4) main-shaft auxiliary generator. Relatively speaking, type No. 1 is not so reliable a source but very efficient; type No. 2 is more reliable but less efficient; type No. 3 is equal to type No. 2 in reliability and the efficiency is similar to that of type No. 1; type No. 4 has high efficiency, but the reliability is dependent on the unit to which it is attached unless provision has been made for throwing over the auxiliary of that particular unit to the shaft generators of other units. Attention was called to the difficulty of operating auxiliary generators in parallel with the main unit.

Commenting on the operating conditions that should influence the se-

lection of auxiliary drives, Mr. Bell considered the applications separately. For example, circulating water can be cut down appreciably without reducing the capacity of the prime mover, although the water rate would be increased thereby; therefore, division of circulation water pumping between two units is desirable. Slip-ring or multi-speed control is preferred. Excitation, on the other hand, cannot be interrupted at all, so the source of power must be very reliable. The duplex exciter was referred to as being satisfactory if a Tirrill regulator is used.

A magnetic clutch has been found very satisfactory in connection with such units. Boiler feed may be interrupted for short periods because of the limited capacity of the boiler drums, especially if power is off at the same time. At other times, however, boiler feed should be assured. The speaker told of having depended entirely upon motor-driven boiler-feed pumps in which the feed is controlled by throttling the discharge of the pump with pilot motors and excess-pressure regulators. Condensate pumping must be reliable, and it is preferable to use duplicate pumps. Steam ejectors have been found very reliable for removing air from the condensers. Interruption of stoker and clinker-grinder operations for short periods is not serious, and there is some advantage in stopping or proportionately retarding their operations with a drop in the load. Primary-air supply for powdered-fuel furnaces cannot be interrupted very well without clogging the coal feeders. Reliability of operation as well as reduction of power losses can be obtained simultaneously by driving forced-draft fans with two motors, the speaker declared. The reduction in losses alone when operating at half maximum load will justify the extra investment, he contended. Interconnection of air ducts is another means of assuring reliability of forced-draft supply.

In commenting on the paper by Mr. Bell, G. C. Daniels contended that main-shaft auxiliary generators do not increase the length of the turbine room because the space is required for withdrawing the rotor anyway. Main-shaft auxiliary generators cannot be tied in parallel, the speaker contended, because they will divide the load in the same proportion as the prime movers to which they are attached. Hence it is advisable for each main-shaft auxiliary generator to serve only the auxiliaries of the units to which it is attached, but provision can be made for throwing the auxiliaries of any unit onto the auxiliary generator of another unit. When house turbines are used, the piping and traps required complicate a station, Mr. Daniels asserted. He referred to regulating all boiler-feed pumps from a common source and urged care in the selection of pump characteristics.

Bus Tunnel for Heavy Substation Leads

Lead-Covered Cables Found Impracticable for Heavy Current from 220-Kv. Auto-Transformer Banks to Synchronous Condensers

BY E. A. CRELLIN*

THE layout of apparatus in substations where the incoming voltage is 220 kv. and the outgoing voltage is 110 kv., such as is the case at the Vaca-Dixon substation of the Pacific Gas & Electric Company, presents problems not met with in station design for lower voltages. Such high voltages require exceptionally wide spacings between conductors and large clearances to ground. In addition, the power concentrated in each transformer bank is large, since the capacity of the lines is so great.

At the Vaca-Dixon substation there are now two 50,000-kva. transformer banks in operation, with a third bank of the same capacity being installed, and provision has been made for a fourth bank. These units receive power from the Pit River development at 220 kv. and transform it to 110 kv. for tying into the system network. They are Y-connected auto - transformers with solidly grounded neutral.

In addition to the 220/110 kv. auto-transformation, the transformers have a delta-connected 11,000-volt winding, capable of supplying 40,000 kva. for synchronous condenser operation, and a separate 3,300-volt delta-connected winding to furnish reduced voltage for starting the condensers. The substation now has installed two 20,000-kva. synchronous condensers with a third unit of 40,000-kva. capacity on order and scheduled for early delivery.

The combination above outlined sets up some difficult problems in the routing of conductors. The natural location of the transformers is in a line parallel to the long axis of the substation building and as close as

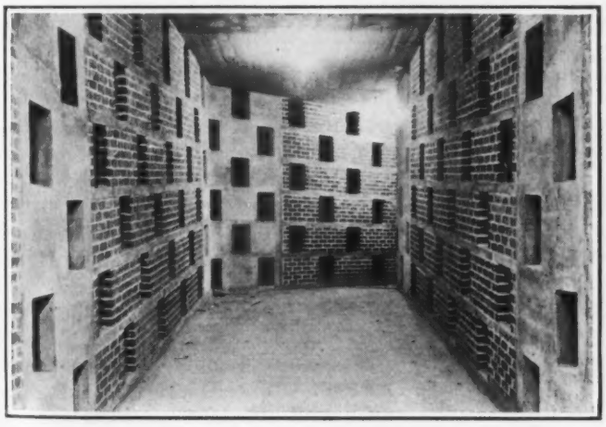


FIG. 1—BUS TUNNEL AT VACA-DIXON SUBSTATION FOR 11,000-VOLT AND 3,300-VOLT LEADS

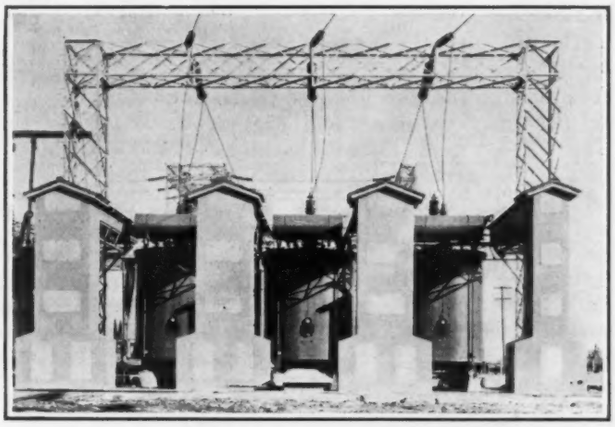


FIG. 2—CONCRETE RISERS FOR 11,000-VOLT AND 3,300-VOLT LEADS FROM TRANSFORMER TERMINALS TO BUS TUNNEL

*Assistant engineer division of hydro-electric and transmission engineering, Pacific Gas & Electric Company, San Francisco.

possible to the 11,000-volt bus structure, but this involves crossing of the 220-kv. and 110-kv. lines and is impracticable. The only suitable arrangement of transformers is in a line at right angles to the long axis of the substation, with the 220-kv. lines entering from one side and the 110-kv. lines leaving from the other side.

This places the more remote transformers at a considerable distance from the substation and requires exceptionally long runs for the 11,000-volt and 3,300-volt leads to the condensers in the substation building, which must each be of a capacity sufficient to carry 2,100 amp. per phase. Paper-insulated, lead-covered cables in ducts or in a tunnel were considered for this service, but the cable makers were extremely cautious in their guarantees of carrying capacity in view of the fact that the summer temperature is frequently well over 110 deg. F., and it would have required at least two 2,000,000-circ.mil cables per transformer terminal (and there are four terminals on each unit) or three 2,000,000-circ.mil cables per phase to carry the load.

The difficulties in the way of placing a large number of outdoor cable terminals on the tops of these transformers may be seen from Fig. 3. The 220-kv. and 110-kv. bushings occupy the center of the top. In addition, there are the two 11-kv. and two 3,300-volt terminals as well as the grounded end of the high-voltage winding. There are also two hand holes, an oil conservator and a pressure relief pipe. After considerable study the use of lead-covered cables was abandoned in favor of a bus tunnel, which was only slightly more expensive in first cost but which was far superior as regards reliability.

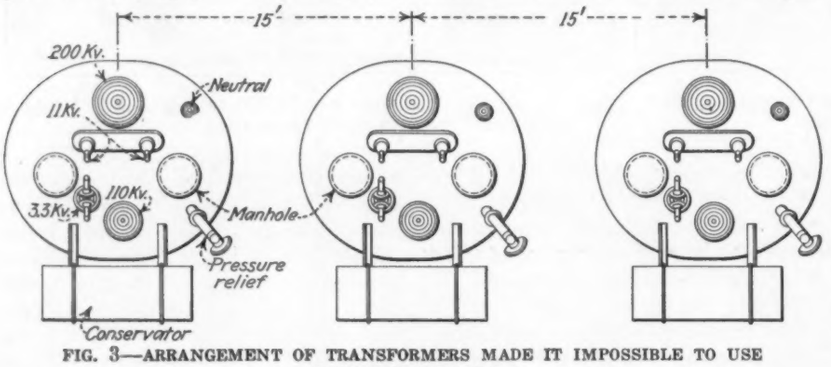


FIG. 3—ARRANGEMENT OF TRANSFORMERS MADE IT IMPOSSIBLE TO USE LEAD-COVERED CABLE

Fig. 1 is a view looking into the bus tunnel from the point where it enters the substation building. Construction costs were reduced to a minimum by the use of precast concrete slabs and brickwork on all sections which were uniform. At angles or points where there was a change in grade necessitating special construction the entire special section was formed and poured of concrete. The tunnel for transformer banks No. 1 and No. 2 is about 250 ft. long and that for transformer banks No. 3 and No. 4 is about 420 ft. long.

Each lead consists of three laminations of ¼-in. x 4-in. copper bar set vertically on insulators spaced 4-ft. 9-in. center to center. The upper three compartments on each side of the tunnel carry the 11-kv. leads, while the lower three compartments carry the 3,300-volt leads. The tunnel is well lighted and affords an opportunity for easy and frequent inspection of the buses.

The risers from the tunnel through which connection is made to the transformer terminals are shown in Fig. 2. Note the simplicity of the high-voltage connections, the 220-kv. lines coming in from the background and the 110-kv. lines continuing on in the same line.

The high-voltage bushings are just visible above the conservator tank. All low-voltage leads are fully protected and covered except at the point of connection to the transformer terminals, and every precaution has been taken to insure complete reliability of service. Two banks have now been in operation for more than two years, and the complete dependability of the layout as installed has been fully demonstrated.

Specifications for Pole Preservation

Red Cedar and Yellow Pine Used to Large Extent for Lines—Detail Instructions for Treatment—Facts to Be Noted During Process

AT THE present time the two woods lending themselves most admirably to preservative treatment in pole-line construction are Western red cedar and long-leaf yellow pine, according to a statement made by C. W. Nickerson of the Yonkers Electric Light & Power Company in a paper presented before the Empire State Gas and Electric Association at Syracuse, N. Y. With Western red cedar the light weight of the poles facilitates handling them in rough country and reduces transportation and erection costs. Their symmetry overrules objections against overhead construction. They carry heavy loads and withstand strenuous topographical and weather conditions. Long-leaf yellow pine is ideal pole material, straight, of even taper and high tensile strength.

These qualities in the above woods are preserved by the proper application of creosote oil, imparting immunity from the attacks of fungus, which is the agent of decay, as well as from ants and birds. Fire hazard is reduced as the charring of the surface seals the interior against atmosphere in sufficient quantity to support combustion.

Western red-cedar poles are either butt-treated by the Pentrex method or dipped in tanks by standard prescribed methods. The long-leaf yellow-pine poles are treated their entire length in a cylinder either by the pressure (empty-cell) process or vacuum (full-cell) process in accordance with standard specifications.

Modern equipment, labor-saving devices and mechanical handling of material give maximum efficiency. Poles should not be dragged, as they gather dirt in this way and are bruised and scarred. In the storage of poles care should be taken with the same idea and plan of conservation in mind, namely, that creosoted timbers should be properly placed in ramps to form a track or on skids in order that there may be air circulation underneath the poles. There should be as little handling as possible, and in the handling the poles should be continually rolled to the front of the pile, where they can be removed as used.

It was brought out in a discussion of preservation of poles by the over-

head distribution committee that the use of creosote as a preservative in cities had many objections, on account of the poles dripping, and further that it caused the blistering of workmen's faces and arms in hot weather because of carbolic-acid fumes exuding from the poles.

According to Mr. Nickerson, it is the policy of many companies to purchase material on a competitive-bid basis, and even though rigid specifications are drawn up by the engineer, the quality of the goods delivered is not always strictly in accordance with specifications. Sometimes the manufacturer whose bid is the lowest gets the business on an unfair bid or an unfair basis; viz., in a carload of poles he ships many which are undersized and also poles that are more or less defective or crooked. These defects are often passed unnoticed. Then, again, discrepancy occurs in the quality of preservative and the method of treating that this cheaper manufacturer uses. When this question is brought to his attention, he simply says: "Well, my poles are up to specifications, and also you may take any means available to test the oil. My methods of treatment are of the highest order." But the engineer knows that he is not receiving the quality of material that he specified.

The following instructions form a part of the specifications for creosoted long-leaf yellow-pine poles treated by the Rueping or empty-cell process:

The poles to be treated shall all be air-seasoned until, in the judgment of the inspector, any moisture in them will not prevent injection of an adequate amount of preservative. The preservative used shall conform to the American Wood Preservers' Association creosote oil, grade No. 1. The poles shall have a final retention of at least 8 lb. of creosote oil per cubic foot of wood and shall have an initial injection of at least 16 lb. per cubic foot. After the poles are placed in the cylinder, the preservative shall be introduced, at not over 200 deg. F. until the cylinder is filled.

The pressure shall be raised and maintained until there is 16 lb. of creosote oil injected into the timber. The pressure and temperature within the cylinder shall be controlled so as to give the maximum penetration by the quantity of preservative injected. After the pressure is completed the cylinder shall be speedily emptied of preservative and a vacuum of at least 22 in. promptly created and maintained until the quantity of preservative injected is reduced to the required retention.

The treating plant shall be equipped with the thermometer and gages necessary accurately to indicate and record conditions at all stages during the treatment.

Facts to Be Noted.—First, that the poles are not properly air-seasoned until all moisture is removed—a manufacturer will defy any one to prove that he has not properly air-seasoned his poles; second, that the grade of oil used is not inferior; third, be sure that the Rueping or empty-cell process, which is the prescribed method of treating long-leaf yellow-pine poles, is always followed out—that the time is not shortened or some local method used in order to hasten the process.

According to Mr. Nickerson, high-grade manufacturers such as the Long-Bell Lumber Company and the International Pole Company have great natural resources and extensive storage yards. They can, therefore, cut their timber in advance, season it properly and, after preservative treatment, can store their product on raised creosoted ramps and turn the poles periodically for a period of several weeks. By this method all leaching ceases by the time the pole arrives in the pole yard ready to be installed on the lines. In this way the objections made by pedestrians who come in contact with the pole that is leaching or oozing oil are overcome.

The oil shall be a distillate of coal-gas or coke-oven tar. It shall comply with the following requirements:

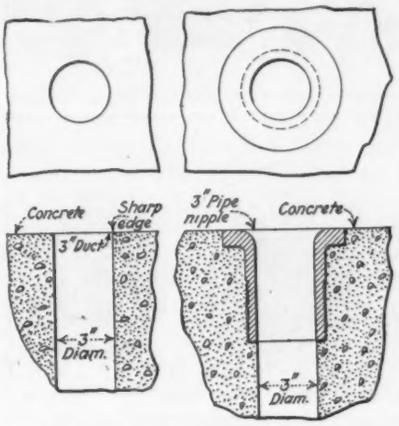
1. It shall not contain more than 3 per cent of water.
2. It shall not contain more than 0.5 per cent of matter insoluble in benzol.
3. The specific gravity of the oil at 38 deg. as compared with water at 15.5 deg. C. shall be not less than 1.03.
4. The distillate, based on water-free oil, shall be within the following limits: Up to 210 deg. C. not more than 5 per cent, and up to 235 deg. C. not more than 25 per cent.
5. The specific gravity of the fraction between 235 deg. C. and 315 deg. C. shall be not less than 1.03 at 38 deg. compared with water at 15.5 deg. C. The specific gravity of the fraction between 315 deg. and 355 deg. C. shall be not less than 1.10 at 38 deg. compared with water at 15.5 deg. C.
6. The residue above 355 deg. C., if it exceeds 5 per cent, shall have a float test of not more than 50 seconds at 70 deg. C.
7. The oil shall yield not more than 2 per cent coke residue.
8. The foregoing tests shall be made in accordance with the standard methods of the American Wood Preservers' Association.

Provided that the manufacturer uses the oil specified above or an English oil which has similar specifications, there will be no complaint from the men handling these poles with respect to the blistering of their faces and arms in hot weather due to any carbolic-acid fumes being given off.

In summing up, Mr. Nickerson said that there will be no trouble in using a treated pole, either a red-cedar butt-treated or a creosoted yellow-pine pole, if the utility companies will prepare rigid specifications and purchase from a reliable manufacturer.

Protecting Cable Insulation

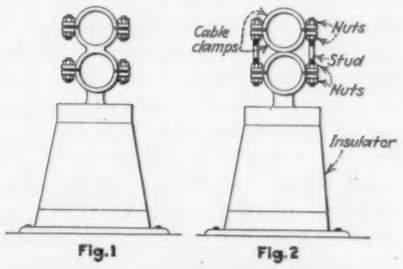
WHEN concrete ducts are used instead of fiber pipes for holding cables the insulation is easily damaged by the sharp edges of the concrete ducts when the cable is drawn in. To prevent the insulation from becoming damaged one substation construction company is using nipples at the duct ends as shown herewith.



STEEL NIPPLE USED IN CONCRETE TO PREVENT CABLE ABRASION

Double-Conductor-Type Insulators

TO HAVE obtained additional double-conductor insulators for 1,500,000-circ.mil cable of the type shown in Fig. 1 would have delayed completion of a certain job. For this



METHOD OF CONVERTING SINGLE-CONDUCTOR INSULATORS TO THE DOUBLE TYPE

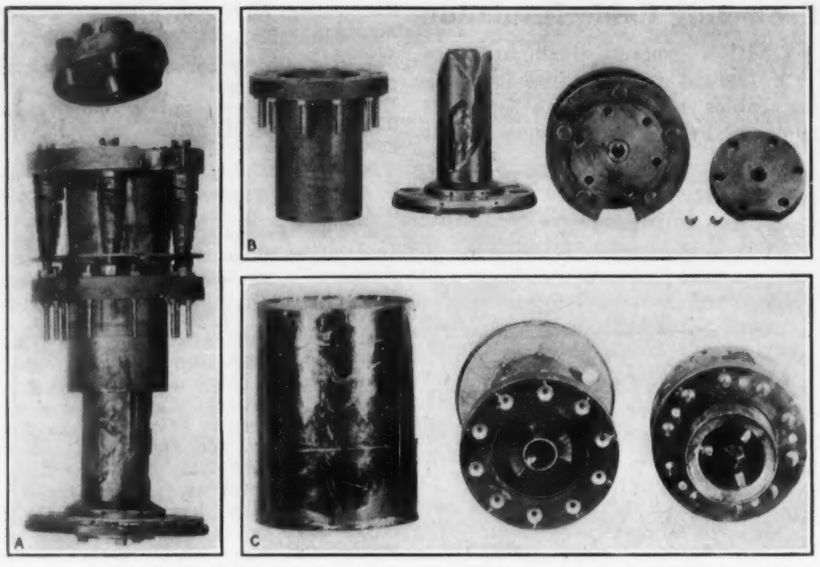


FIG. 1—DETAILS OF COUPLER FOR LOWERING HEAVY FIXTURE FROM CEILING

reason a construction company converted some spare single-conductor cable insulators to the double-conductor type shown in Fig. 2. This was done by using two additional cable clamps from other insulators. These clamps were fastened to the single-conductor insulator with threaded studs and nuts as shown.

Coupler for Lowering Heavy Fixtures

BY H. M. BROWN
Designing Engineer Fuchs Electric Company, Chicago, Ill.

IN ORDER to provide easy means for raising and lowering four 1,500-lb. fixtures installed at the Jewish Temple Isaiah in Chicago, couplers were designed, these being shown in Fig. 1A, B and C. The main problem in providing a flexible method of lowering fixtures for cleaning and relamping in this temple was one imposed by the design of the building itself. The main part of the building is a large dome constructed of a layer of "gustavino," then concrete and upon this roof tile. On account of the height, 75 ft., and the fact that no disfigurement of the dome ceiling would be allowed, the problem of correctly designing a special coupler in keeping with the surroundings had to be solved.

All these objections were surmounted by the erection of equipment illustrated in Fig. 2. Each coupler is fastened to a steel plate, $\frac{3}{4}$ in. x 36 in. x 36 in., embedded in the roof. The cable holding the fixture is carried through the tubing of this coupler over rollers down back of the dome ceiling to a winch used for hoisting and lowering the fixture. Each fixture has five two-wire circuits connected to it. These ten electrical connections are guided into their correct position by a keyway cut in the bottom portion of the coupler hanger. This keyway is cut across the surface on such an angle that the electrical connections will always come up in the same position when the fixture is pulled up.

The mechanical coupling consists of three $\frac{7}{8}$-in. x $\frac{9}{16}$-in. chrome-nickel steel lugs, which engage into grooves cut in the upper portion of the hanger (Fig. 1). The three steel lugs on the lower portion of the hanger are mounted on a cup-shaped body of drop-forged steel, which turns on a ball bearing. When the coupler is pulled together the bottom piece is free to turn so that the lugs can come up into the grooves. The bottom piece turns about 100 deg. When the lugs reach the bottom of these grooves, the weight is taken off the cable and supported by the coupler itself. To lower and release the fixture it is only necessary to raise the winch cable approximately 2 in., which then turns the parts carrying the lugs around to the straight grooves. Then by reversing the direction of the winch the fixture can be lowered 75 ft. to the floor level.

The entire coupler is dust-proof and has been tested under load up to 3 tons. The main features of this coupler are these: All parts carrying load are made of drop-forged steel; the lugs are chrome-nickel steel; the contacts are of ample size to take care of the current supply (50 amp. each) to the fixture, since there are no moving parts in the upper portion of the fixture, which is bolted direct to the ceiling. Thus there is nothing to get out of order. On the lower portion of the coupler the only moving part is the one carrying the steel lugs, which moves on the ball bearing. This bearing carries no weight when the coupler is in position. This lower part carries only from 15 lb. to 20 lb. when it goes into the locked position because the entire fixture weight is then suspended from the cable.

The construction that has been employed has complied with the requirements of the Electrical Inspection Bureau of the City of Chicago, which requires that ceiling fixtures using cable for lowering shall have additional means of fixture support and shall be entirely independent of any support that may be afforded by the cable.

This design was made by the author, who has also patented it.

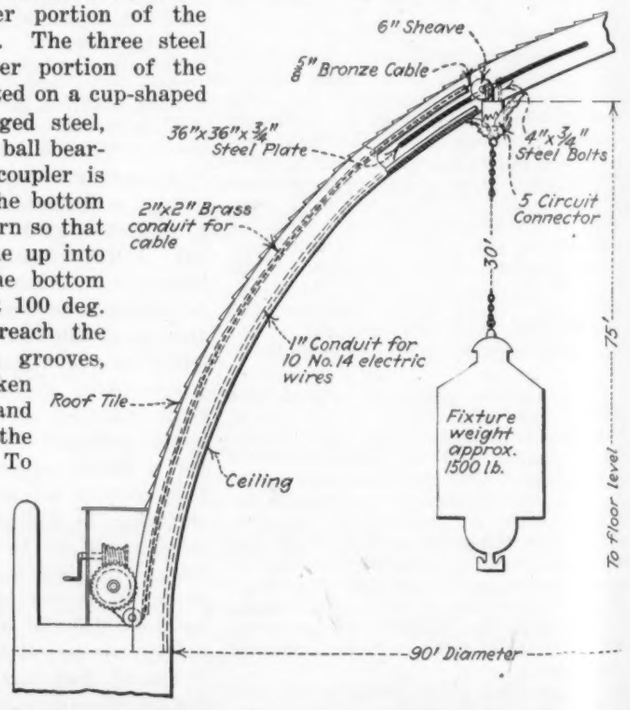


FIG. 2—ENTIRE LAYOUT FOR FIXTURE-LOWERING APPARATUS

Commercial Activities and Public Relations

Political Viewpoints on Utility Practices

FOUR men, well known in Kansas, but who are outside of the utility industry, recently expressed viewpoints on utility practices which indicate a trend of thinking on the part of public office holders that is most encouraging to those in the industry. The men, all of whom hold important public positions, were Jesse Greenleaf, chairman of the Kansas Public Utilities Commission; E. T. Hackney, also a member of the commission; Mayor Earl Hawkins of Emporia and Mayor Earl Akers of Topeka. Mr. Greenleaf contended that state commissions should not try arbitrarily to substitute their judgment for that of utility managers, but should serve as the instigators of conferences in which mutual problems of the public and utilities may be settled harmoniously and equitably. Despite the apparent obstacles involved, Mr. Greenleaf was emphatic in his belief that the Kansas commission has been able to carry out this policy in handling every case. Referring to the constructive development of public good will Mr. Hackney urged the utilities to base their campaigns on a firm foundation by convincing the public of their honesty of purpose and thereby remove any cause for suspicion or mistrust.

Both city executives indicated an unusually sympathetic attitude toward electric power utilities and evinced no patience with any public officials who would attack the public service companies to further their political ends. Mayor Akers recalled the time when he thought he would be rendering a public service by "lifting the yoke of utility oppression," but added that it is possible for any one to learn better if he lives long enough. He felt that present-day utilities, as contrasted with the practices of the old school, are building a monument to honesty and integrity of purpose which is evidenced by their service practices and above-board policies. Executives are realizing, he added, that men and women who can carry out these policies are the most economical to employ.

Differences still exist, he admitted, but he has been able to settle them equitably in conference without acrimonious argument or attracting unfavorable public notice. Any political officer who tries to use his authority as a bludgeon and who cannot settle differences in a harmonious manner is, in this mayor's estimation, a dangerous person and a public liability. Several constructive suggestions were offered by these public men. For example, if utilities will think of political officers as public representatives who are trying to do the right thing, more satisfactory results can be obtained in dealing with them. Utilities can avoid trouble by "putting all their cards on the table." When apparently opposing interests get together, they will find a mutuality of purpose which they did not previously suspect and that the only reason they did not get along before was that they had not tried. He concluded by declaring that utilities are entitled to a reasonable return on investments and that he had no patience with any individual or group that denies this right.

Merchandising Practice for Industrial Power Department

How the Baltimore Company Draws Up Specifications, Sells and Supervises the Installation of Electrical Equipment for Its Power Customers

THE primary duty and work of the industrial power department of the Consolidated Gas, Electric Light & Power Company of Baltimore is to obtain new business, but the company feels that its obligation to customers would not be fulfilled without taking care of their needs as to equipment. To meet this obligation the industrial power department of the Baltimore company carries in stock and sells to its power customers motors, transformers, rotary converters and other electrical equipment, including industrial electric heating devices and electric ranges.

All equipment is sold at manufacturers' listed retail prices except in the cases of large users (more than 200 hp.), where a 10 per cent discount is allowed from the retail price, the same as is allowed by the manufacturers.

TERMS OF PAYMENT

In most cases payment is made in cash or at thirty days. Where this is not done and the payment extends over a three-month period, it is customary to obtain a first payment of 40 per cent of the selling price in cash, the balance to be paid in three monthly installments with no interest or carrying charges made. Where a payment period of six months or longer is asked for by the customer and his credit is good, a first payment of 25 per cent of the selling price in cash is arranged, the other payments to be made in equal monthly amounts with interest. An effort is made to confine the payment period within six months, and in no case does it extend beyond twelve months.

OPERATING EXPENSES

As nearly as possible all expense incurred in sales is charged to this work. Motors are handled through a special account, to which are charged 50 per cent of one man's salary and 10 per cent of the salaries of the industrial power department sales representatives. The number of men varies between seven and twelve. No portion of office rental is charged to this account. The storeroom expense for storing and handling the motors is charged outgoing whenever motors leave the storeroom. If motors are returned, an additional charge is made.

In order to care for customers' immediate requirements, motor equipment amounting in value to between $50,000 and $75,000 is kept in stock at all times. This equipment is not only available for new sales, but also for any customer who may have a breakdown in his steam or electrical equipment and require a motor for immediate use in order to keep his plant in operation. The

company is called on regularly by its customers for this service, and in many cases it has been found that customers prefer to deal with the company, even paying more than they would elsewhere.

EMERGENCY SERVICE

To care for customers' requirements and meet emergencies the company maintains a motor-service crew, which is at all times available day or night to give immediate attention to calls from customers relative to any motor trouble that may occur.

PARTIAL VIEW OF MOTOR STOCK CARRIED BY THE CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY OF BALTIMORE

If any existing trouble cannot be remedied, proper equipment is drawn from stock and loaned to the customer on rental while his equipment is brought in to the repair shop for the necessary repairs.

In the sale of transformers the company gets out specifications covering the customer's requirements and asks for competitive bids from three or more manufacturers, selling to the customer on the basis of prices obtained, preformance and customer's preference. Occasionally it is necessary to buy a single transformer or a group of three transformers where there is not time to wait for specifications and bids. In these cases purchases are made at the best discounts obtainable from the manufacturers. Payments are made on the same basis as for motors.

Rotary converters are handled and sold in the same manner as motors and transformers.

Frequently in changing over an existing steam plant from engine and shafting drive it is necessary to lay out the wiring diagram and make up wiring specifications for the new motor installation. The company gets out specifications and blueprints for the necessary wiring work and submits these to about six electrical contractors for competitive prices, leaving the awarding of the job to the customer, but supervising the actual wiring installation when made.

Upon completion of the work the contractor is paid cash by the company. It in turn, where possible, obtains a cash or thirty-day payment from the customer, but where the customer so desires he is allowed monthly payments over a period as short as can be arranged and in no case exceeding twelve months. In all cases of time payments interest and carrying charges are added.

HIGH-TENSION CUSTOMERS' SUBSTATIONS

In all cases where a customer buys energy on the high-tension schedule it is necessary for him to install, or have installed at his expense, step-down transformers in a fireproof building or vault with proper high-voltage protective equipment and with arrangements for high-tension metering. The industrial power department will give the customer an approximate cost of the necessary building and of the wiring and installation costs free of charge. The next step is to have the company's engineering and construction department make a definite lay-out with blue prints and specified lists of material, together with quotations on the building and the installation.

In changing over the isolated plants to electric drive and purchased power, the Consolidated company has in a few cases made trial-period agreements with certain customers at the customer's request, whereby the company has installed or had installed the necessary motors, transformers or other electrical equipment for a trial of one or sometimes two years. During this period the company charges the customer an annual rental to cover depreciation, interest and carrying charges. If at the end of the trial period the customer is satisfied with the service and decides to continue operation therefrom, the customer purchases the equipment, the company crediting him with the annual rentals that he has paid and adding an interest and carrying charge to the principal sum.

The value of this general policy to the Consolidated Gas, Electric Light & Power Company has been demonstrated a number of times by the fact that customers have definitely stated that they preferred to pay the company an additional charge above the cost of installation to assure themselves of the company's supervisory service, in which they had full confidence. Frequently, also, the closing of a power contract or the shutting down of a private plant has hinged upon the company's readiness to furnish proper specifications for the electrical equipment and to hasten its delivery and installation at the most reasonable cost to the customer.

Central-Station Appliance Sales Show Big Gain

MERCHANDISE sales of the Union Electric Light & Power Company, St. Louis, were 37.7 per cent larger in December, 1924, than in December, 1923. The December, 1924, sales were the largest for any month in the history of the company, and the sales on December 22, 1924, were the largest for any single day. How this increase in sales was distributed is indicated in the following list of principal articles:

	Inc., per Cent		Inc., per Cent
Irons	72	Cleaners	77
Grills	117	Sewing-machine motors	46
Waffle irons	14	Washers	56
Heating pads	30	Portable lamps	34
Radiators	81		

Refrigerator Revenue $200 per Kilowatt of Demand

DOMESTIC electric refrigerators because of their revenue-earning possibilities should be accorded the active sales support of all electric service companies, declared G. M. Dwelley, sales manager of the Kelvinator Corporation, before a gathering of utility men recently. Around fifty thousand domestic electric refrigerators are already in service in the United States, he said. Furthermore, they are not such a young development, production having started back as far as 1914.

To substantiate his first declaration, Mr. Dwelley pointed out that committees of the N. E. L. A. and Association of Edison Companies have agreed that domestic electric refrigeration because of its desirable load characteristics constitutes the best possible appliance load for central stations. The annual revenue per watt of demand tops that of most other appliances. The daily maximum demand occurs after meals, and the yearly maximum demand comes during the summer when other loads are light. The frequently intermittent load of individual units is of such a character as to give excellent system diversity and still have the earmarks of a continuous load. Four refrigerators have a combined demand equivalent to ¼ hp. continuously, Mr. Dwelley pointed out. No additional service investment is required because of the small maximum demand.

A comparison of domestic electric refrigeration with other domestic loads is afforded by the accompanying table. Even at a 4-cent rate a central-station could expect $32,000 revenue a year out of 1,000 domestic refrigerators, Mr. Dwelley maintained.

Need of servicing, which at present seems to be the only question in the minds of central-station men, has decreased remarkably in the newer types and models. Records kept on Kelvinator installations indicate a reduction in number of service calls per installation per year from 1.9 in 1922 to 1.6 in 1923, Mr. Dwelley announced. The N. E. L. A. committee on the subject estimates that the average servicing cost on the better types and models is less than $5 per year, he added.

According to a survey made by the Bonner Springs (Kan.) company among a number of its refrigerator users who had had the equipment long enough to judge, none had experienced any trouble, and all favored the electric refrigerator over icing in the old manner and declared they would repeat the purchase if they had to reconsider it. Ninety-five per cent of the users had never had an interruption of service, and those experienced were due to minor causes. As a further indication of customers' satisfaction the Kansas Gas & Electric Company placed seventy-two refrigerators on trial with customers and not one was sent back.

In urging utility commercial departments to capitalize on domestic refrigerator load, Mr. Dwelley warned his listeners to seek out the best machine and tie to it. In doing so, he pointed out, the company should consider the financial backing of the manufacturer, the ability to turn out the product, its experience and the patience of the company in pioneering a new development. Furthermore, he contended that adequate servicing facilities should be provided before attempting a selling campaign. Until utilities have men properly trained to sell refrigerators and maintain them, he thought, they should not go into direct sales.

COMPARATIVE DEMANDS, ENERGY CONSUMPTIONS AND ANNUAL REVENUES OF HOUSEHOLD APPLIANCES AT 8-CENT RATE

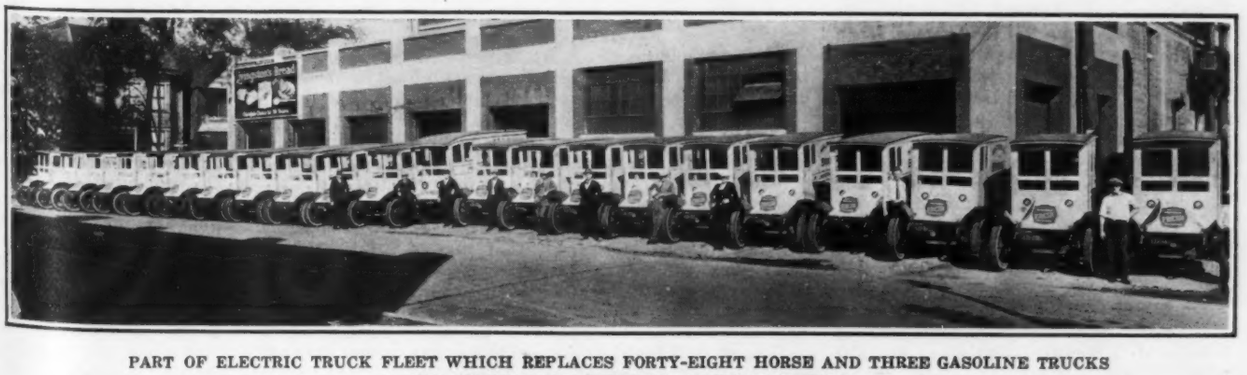
Appliance	Maximum Demand, Watts	Annual Kw.-Hr.	Annual Revenue	Annual Revenue per Kw. Demand
Heaters	600	42	$3.36	$5.60
Toasters	500	37	2.96	5.92
Washing machines	300	25	2.00	6.66
Percolators	400	42	3.36	8.40
Flatirons	600	72	5.76	9.60
Fans	50	16	1.28	25.60
Sewing machines	50	17	1.36	28.20
Ranges	2,500	1,500	120.00	48.00
Refrigerators	300	800	64.00	213.00

Chicago's Sales of Trucks Increase 55 per Cent

ELECTRIC truck sales in Chicago during the year 1924 showed an increase of 55 per cent over sales for 1923 and nearly equaled the total sales for the two years of 1922 and 1923. While gasoline trucks showed a decrease in sales throughout the country for 1924, sales of "electrics" showed a gain of approximately 10 per cent for the same period.

Included in the increases for Chicago were additions made to existing fleets of thirty-nine users and the conversion to the use of electric trucks of nineteen new firms. The Livingston Baking Company, which had no electric trucks at the beginning of 1924, during the year replaced forty-eight horses, thirty-six wagons and three gasoline truck with thirty-nine "electrics." These cover all routes twice instead of once as was the practice formerly.

The Ira J. Mix Dairy Company, placed an order for a fleet of twelve electric trucks at the beginning of 1925, displacing horse-drawn equipment, and has since added two more.



PART OF ELECTRIC TRUCK FLEET WHICH REPLACES FORTY-EIGHT HORSE AND THREE GASOLINE TRUCKS AND COVERS THE TERRITORY TWICE AS OFTEN

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Water-Power Plant at Forshuvudforsen, Sweden, Using Roller Dams.—This plant, designed for an installation of 15,600 kw., illustrates the latest Swedish practice in a number of directions, such as the use of large roller dams, the arrangement of fish screens and trash racks, the prevention of ice troubles at the racks, etc. Unlike many other Swedish developments, it is a private undertaking, being constructed by one of the oldest business concerns in existence, the Stora Kopparberg Company, which dates from about 1285. The present installment deals almost solely with the four cylindrical rollers, from 12.3 ft. to 29 ft. high, which close the sluice openings, each 55.8 ft. wide. These are described in detail and liberally illustrated by drawings in the text and a four-page insert plate.—*Engineering*, Jan. 2, 1925.

Heat-Cycle Efficiencies.—LIONEL S. MARKS.—The author urges the general adoption of an "ideal cycle efficiency" as a standard for computing engine efficiency, defined as "that efficiency obtained when every portion of the heat taken in operates through a Carnot cycle the temperature limits of which are (1) the temperature at which the heat is taken in and (2) the exhaust temperature at which it leaves the cycle." In this connection temperature-entropy diagrams are given for various cycles used in current practice.—*Power*, January 20, 1925.

Water-Power Resources of the World.—J. W. MEARES.—From papers presented at the first World Power Conference the author has compiled an estimate of the entire water power, developed and available, of the earth. It is summarized by countries and by continents, with citation of references to the sources of information, and an explanation of the reduction factors used to bring the data to a common basis. He arrives at a total of 138,000,000 kw. of continuous or 90 per cent power.—*World Power*, January, 1925.

Generation, Control, Switching and Protection

Synchronous Condensers as Voltage Regulators.—F. GRIEB.—To reduce the possible maximum to which the short-circuit current can rise in large and extended transmission systems, the impedance of such systems is purposely increased. One of the simplest ways to accomplish this is to design the main transformers on the line with a reactance of 10 per cent or more. But this in turn will cause a very considerable voltage drop, particularly at lower power factor. Among the three known methods to regulate the voltage on a system—or, rather, to keep the net voltage constant—which are compounding with taps on transformers, by means of induction regulators or with synchronous condensers, the author shows that the last-mentioned method is far the best. A synchronous condenser will not only maintain constant voltage, thus avoiding the necessity of weakening transformers with taps, but it will at the same time keep the power factor of the system at unity, permitting a maximum of kilowatts to be transmitted. Properly arranged, both voltage and power-factor regulation can be made fully automatic. — *Brown-Boveri Mitteilungen*, January, 1925.

The Kapp Phase Advancer.—CYRIL SYLVESTER.—In a communication the writer takes exception to alleged unfavorable criticism of the Kapp device in the *Electrician's* article on "Phase Advancers" of Dec. 19. He explains the action with the aid of sine curves. The two discussions, the original and that in the letter, are supplementary rather than antagonistic.—*Electrician (England)*, Jan. 9, 1925.

Riverside Station of the United Light & Power Company.—The plant here described and now under construction at Davenport, Iowa, is designed for an ultimate installation of 150,000 kva. The first 25,000-kva. unit is in operation. All auxiliaries will normally be operated electrically off the main bus, steam being bled from the main turbine for heating the feed-water, which is fed to the boilers at 350 degrees. Steam is used at 400 lb. gage pressure, superheated to 700 deg. The plant is described in detail with illustrations, efficiency curves and data on the principal equipment. — *Power*, Jan. 13, 1925.

Transmission, Substations and Distribution

New Type of High-Tension Network.—This is a discussion of a paper presented at the A. I. E. E. spring convention, of which a report may be found in the ELECTRICAL WORLD for April 19, 1924.—*Journal of A. I. E. E.*, January, 1925.

Economics of Interconnection of Large Steam-Power Systems.—EGBERT DOUGLAS.—The author contends that while the interconnection of water powers, when not too widely separated, seems in general to be justified, this does not necessarily follow in the case of steam plants. The economy of a well-designed plant of 20,000 kw. will not differ greatly from that of one several times as large, and the small gain may well be offset by the cost of transmission lines, especially since no load center requiring, say, 10,000 kw. can be served in any case without labor for operation and maintenance. Moreover, growth in size is not always attended by improvement in load factor. He cites examples, giving operating statistics for successive years, where the peaks have increased in a higher ratio than the annual output. Unfortunately the data cover only the years 1917 to 1919, which were in many respects abnormal. There is no indication as to whether this condition has continued. He suggests that territorial expansion may result in an increase rather than a decrease in power costs, because the expansion must be into more sparsely populated regions.—*Power*, Jan. 13, 1925.

Lightning Arresters, Lightning Arrester Tests, Lightning-Arrester Experience in California.—This is a discussion of papers presented at the spring convention of the A. I. E. E., of which a report may be found in the ELECTRICAL WORLD for April 19, 1924.—*Journal of A. I. E. E.*, January, 1925.

Units, Measurements and Instruments

Graphical Estimation of Magnetic Field Surrounding a System of Conductors.—W. FORDHAM COOPER.—The field at a given point near a long straight conductor, or one curved to a form easily expressed analytically, can be computed arithmetically, according to well-known formulas. For other shapes approximations have to be used, often at the cost of much time. To meet this condition a graphical method was devised which proved simple and expeditious and could be applied to complicated cases by persons unskilled in mathematics. With the aid of a specially ruled sheet of traction cloth, laid out in polar co-ordinates to decimals of a radian, the field per unit current due to successive short lengths of conductor is read off directly from the drawing. Simple addition and multiplication by a factor for the current and the scale of the drawing gives the field at once in c.g.s. units. The mathematical basis of the method and the manner of using it are clearly explained.—*World Power*, January, 1925.

New Physical Apparatus. — Under the caption "Physical Society Exhibition" some new devices recently shown at the Imperial College of Science are briefly described, among them an airship strain gage in which the elongation of the piece under investigation changes the reluctance of a magnetic circuit, a frequency meter with five ranges extending in all from 180 cycles to 4,000 cycles per second, depending for its functioning upon a balance of mutual inductance against resistance, a photo-electric cell, a traction recorder and other apparatus. The cell is of the colloidal film (potassium or calcium) type, giving an electron emission proportional to the incident light, with the current amplified by ionization of helium. The current is of the order of 10^{-9} amp. for 1 meter-candle.—*Engineering (England)*, Jan. 9 and 16, 1925, and *Electrician (England)*, Jan. 16, 1925.

Atmospherics.—R. L. SMITH-ROSE.—The study of natural electric waves initiated by Popoff in 1895, and at that time limited by the insensitive apparatus, has developed into investigations as to their origin, direction and wave form and the location of thunderstorms. The results are here brought together, with a list of twenty references, most of them to publications of the last few years. Curves obtained with an aperiodic aerial circuit and a cathode-ray oscillograph, and reproduced in the article, show that the pulses measured were generally of the aperiodic or quasi-aperiodic type, though sometimes with

a superimposed ripple. The duration was of the order of 0.02 second, and the intensity of field change of the order of 0.1 volt per meter, or roughly a thousand times that for good commercial signals. The present tendency in combating atmospherics is by using directional reception; the solution by using short waves is also being investigated.—*World Power*, January, 1925.

Motors and Control

Motors with Forced-Air Cooling.—P. SUTER.—Whenever this type of motor is required for belt drive, where a sliding adjustment of the motor is needed to regulate the belt tension, special provision has to be made for some sort of flexible-tube connection to the air intake and the exhaust. Such an arrangement is not always satisfactory, for which reason a Swiss concern has developed a new line of forced-draft inclosed motors placed upon a special hollow-cast base. Suitable slots are provided in this base, which correspond to intake and exhaust openings on the motors, with a felt cushion between as a gasket material. As the slots in the base are smaller than the holes in the motor frame, such an arrangement permits a side movement of the motor on the base of as much as 3½ in. one direction.—*Brown-Boveri Mitteilungen*, January, 1925.

Operation of Electric Elevator Machines.—Traction Type Equipment.—F. A. ANNETT.—This is an illustrated article which in simple terms explains the operation of the traction-type machine in its several forms, such as the high-speed direct traction, gearless and geared, and the use of two-to-one roping. It includes a consideration of safety features, buffers and brakes.—*Power*, January 13, 1925.

Heat Applications and Material Handling

Skip Hoists.—GEORGE FREDERICK ZIMMER.—After commenting on the advantages of the fast-running skip hoist for coal handling in power houses the author reproduces an early description and illustration published shortly after the invention of the skip hoist by James Dennett of the Isle of Wight, a century ago. Details are given on electrically driven installations, both vertical and inclined, in several English power stations. Several modern forms of skip hoists are described, one completely automatic, with telpher and with a fan brake that comes into action on the descent, for handling gas coke, and another mounted on a lighter for transferring coal from barge to ship.—*Electrician* (*England*), December 26 and January 2, 1925.

Use of Fluxes in Electric Arc Welding.—C. J. HOLSLAG.—The author states that the chief problem is to shield the molten metal as far as possible from contact with the air and then to dispose of whatever oxides or nitrides have been unavoidably formed. If the proper fluxes are chosen, both these objects may be completely attained. He then discusses the various fluxes that are being used.—*Journal of the American Welding Society*, January, 1925.

Electrometallurgical Applications.—J. L. MCK. YARDLEY.—The processes employed in various electrometallurgical applications are described. In electrolytic work it has been found that it is not necessary or advisable to have a wide voltage range. The most economical all-around installation is one in which the cell, layout or design is of sufficient practicability to demand a comparatively small voltage range in the electrical apparatus. A complete bibliography is added at the end of the article.—*Blast Furnace and Steel Plant*, December, 1924, and January, 1925.

Electrophysics, Electrochemistry and Batteries

Solutions in Storage Batteries.—The Bureau of Standards has conducted several tests on the effect of adding various solutions to storage batteries. These tests followed the claim that certain solutions charged batteries instantly, or in a short time as compared with the usual process. Complete details of the work are given.—*Technical News Bulletin No. 94 of the Bureau of Standards.*

Discharge of Electricity of Insulating Materials.—S. MOCHIZUKI.—The surface discharge of a solid insulation is investigated for the case when the discharge occurs in air and in transformer oil. Under the first condition, with 50-cycle supply, it was found that the negative surface-spark corona takes a circular path a certain distance away from the electrode and that the critical voltage is proportional to the square root of the thickness of insulating materials with a constant depending upon the insulating material. In transformer oils the distinct pole brush cannot be found and the difference of the positive and negative surface-spark corona is not so distinct as in air.—*Journal of Institute of Electrical Engineers of Japan, No.* 436.

Traction

Tunnel Electrification in New Zealand.—This article describes the electrification of the Arthur's Pass section of the Midland line of the New Zealand government railways. The power house, workshop, running sheds, contact line and overhead construction, feeders and cables, tunnel construction, lighting, main-line locomotives and battery locomotives are considered.—*English Electric Journal*, January, 1925.

Turbo-Electric Locomotives.—G. F. JONES and T. L. HALE.—The Ramsay turbo-electric locomotive as it is called, is an experimental one, being designed and constructed for the purpose of obtaining technical data and demonstrating the capabilities of this type. The locomotive consists of two portions, front and rear, connected by a special form of universal joint. The front portion incorporates the boiler, forced-draft apparatus and driver cab, the main turbo-generator being placed under the boiler. The rear portion is devoted mainly to the condensing plant, with axial fans, condensate extracting pump, etc. Each portion of the locomotive carries two driving motors, each pair of motors being bolted to a center cross-bearer which carries a transmitting shaft and spur wheels. The author considers the design and description of the condensing plant, control of power, speed regulation, etc.—*Railway Mechanical Engineer*, January, 1925.

Telegraphy, Telephony, Radio and Signals

Relation Between Telephone Development and General Economic Conditions.—W. C. HELMLE.—The author first discusses some of the questions involved in the general relationship between economic conditions and telephone development and then considers the specific problem of the effect of the fluctuations of business conditions upon telephone-station gains. In this discussion he considers market indices, trends affecting the character of the market, building operations and general business conditions as compared with telephone-station gains.—*Bell Telephone Quarterly*, January, 1925.

Calculation of the Mutual Inductance of Circuits.—F. W. GROVER.—The author considers the calculation of the inductance of circuits which have circular symmetry about a common axis. Tables are given which do away with the necessity of selecting a formula, and the inductance is obtained by taking the product of the geometric mean of the radii and a factor taken by interpolation from a table. An accuracy of one part in ten thousand is attained.—*Scientific Papers No.* 498 *of the Bureau of Standards.*

Miscellaneous

International Progress in Electrical Power Consumption. — The author passes in review the remarkably rapid increase in the use of electric power in Germany, France and Italy and comments on the relative inefficiency of Great Britain in this respect, as shown particularly by the low load factor. He draws the lesson that coal as a primary source of power is no longer pre-eminent and that the supremacy of countries rich in coal is now seriously threatened by countries rich in water power, brown coal or even peat. Efficiency requires large interconnected undertakings and pooling of reserve plant. The comparison is statistical, plant capacities and annual outputs being tabulated for a number of individual companies in each of the countries named. Only totals can be here quoted. Though not strictly comparable, they all apply to some year in the period from 1921 to 1923.—*World Power*, January, 1925.

CAPACITY AND OUTPUT OF FOREIGN UTILITIES

Country or Group	Capacity, Kw.	Annual Output, Millions of Kw-Hr.
Fifteen companies in Germany	1,662,000	4,820
Total in Germany	2,979,000	7,234
Thirteen companies in France, hydro-electric	706,900	1,795
Eight companies in France, steam	1,082,400	2,461
Fourteen companies in Italy	1,075,110	4,153
Total in Italy		5,400
Fourteen companies in Britain	1,062,290	1,792

Scientific & Industrial Research

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

Research Completed

Alternators, Single-Phase, Spring Support for

In large single-phase generators used for supplying power to electrified railways there has been some difficulty from the vibration inherent in single-phase machines. A spring support has been developed for the entire stator, weighing as much as 60 tons in some cases. This method of support prevents the transmission of the stator vibration to the foundations and to the surrounding structures. This development has removed what was becoming a serious limit to the size of single-phase generators.—*Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

Magnetic Properties of Thin Films of Ferromagnetic Metals

Thin films of iron, nickel and cobalt were deposited by the evaporation method on tin or aluminum foil and the magnetic properties studied by an induction method for fields up to 139 gausses. The thickness of the films varied from 20 to 300 millimicrons. The maximum value of the intensity of magnetization has been found to be of the same order of magnitude as for bulk metal.—*A. J. Sorensen, University of Iowa, Ames, Iowa.*

Synchronous Machine with Special Pole Arrangement

The revolving poles are provided with pole shoes of such a form that each two adjacent poles can be excited with the same polarity, thus giving a machine with half the number of poles. The stator winding can also be reconnected for either number of poles. Operated as a motor, this machine can run at two speeds. Operated as a generator at a constant speed, it can generate currents of two different frequencies. The first machine of this type actually built is rated at 5,000/2,500 hp., 24/12 poles, 600/300 r.p.m., two-phase, 2,300 volt.—*R. W. Wieseman, General Electric Company, Schenectady, N. Y.*

Triode Circuits, Analysis of

Two typical triode circuits, used for obtaining regeneration by mutual induction, are examined analytically, with the idea of testing the results of the analysis by experiment. As the experiments were to be performed with a 1,000 cycle current (because of the greater accuracy of measurement at this frequency) it was permissible to neglect the condensive coupling due to the tube elements, and furthermore, as the conditions for the starting of oscillations were to be determined, the current taken by the grid could be neglected as it is only one or two microamperes in the non-oscillatory state. Measurements made on the circuits, by using the alternating-current bridge, confirm the theoretically derived relations to a remarkable degree of precision, showing that triode circuits are susceptible of accurate analysis.—*J. H. Morecroft and A. G. Jensen, Columbia University, New York City.*

Switch, Mercury Flasher

The necessity for providing conspicuous indications at boulevard intersections, railroad crossings or "dead-end streets" has led to the development of a mercury-flasher switch designed so that it causes circuits to be set up to connect and disconnect at regular intervals a lamp installed in a traffic post. It has no wearing parts, the only moving part being a steel armature which floats on the mercury. The electric circuit is completed and broken by the mercury in a vacuum so that there is no wear of arcing surfaces. The life of this unit should be almost indefinite.—*Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

In Progress or Purposed

Dielectrics, Intermittent Tests on

Studies are being made on the effect of repeated application of voltage on the dielectric strength of fibrous insulations. Up to the present time the tests have been confined to 60-cycle voltages and with the materials at room temperatures. Further work is being carried on, covering the effect of intermittently applied stress under various conditions, using direct-current as well as alternating current.—*F. M. Clark, General Electric Company, Pittsfield, Mass.*

Lightning, Study of Protective Devices Against

It is proposed to study and to test lightning protective devices by means of artificial lightning. Materials have been received and parts of apparatus made up.—*R. H. George, Purdue University, Lafayette, Ind.*

Magnetic Permeability and Hysteresis Loss, Effect of Superposed Alternating Current on

It is often assumed that when an alternating-current magnetizing force is superposed on a direct-current magnetizing force the permeability of the magnetic material is increased and the hysteresis loss decreased owing to the shaking-up action on the magnetic particles. These effects are only apparent, as the true permeability and hysteresis remain approximately the same as under direct-current conditions. What are actually measured are the midpoints of displaced minor hysteresis loops. From the known laws of variation of these minor loops, the apparent magnetization curves and hysteresis loops under superposed alternating current can be calculated. Under these assumptions, superposed alternating current actually increases the hysteresis loss instead of suppressing it, as has often been assumed, the resulting hysteresis consisting of that due to an increased major loop plus the losses due to displaced minor loops.—*T. Spooner, Research Laboratory, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

Magnetic Alloys of High Coercive Power

A systematic study is being made of the structures and magnetic properties of iron-cobalt-nickel alloys by varying two constituents and holding the third constant. The ring method is being used.—*A. Hayes and B. E. Rogers, Iowa State College, Ames, Iowa.*

Pivots and Jewels

Arrangements have been made for research on improvement of pivots and jewels used in instruments. The work to be undertaken includes the investigation of the materials employed, the best shape for pivots and cups, the effects of friction and wear and the problems involved in lubrication.—*National Physical Laboratory, London, England.*

Refrigeration, Domestic

Tests are in progress on the operation of refrigerating units as a whole, and also on the size, shape and insulating quantities of the boxes, the size, shape and location of the food and refrigeration compartments, the design of the motor and of the compressor, together with tests on the thermostat and automatic devices.—*H. S. Vassar, Public Service Company, Newark, N. J.*

Resistance, Measurement of Cyclic Changes of

Methods have been developed for the measurement of small cyclic changes in electrical resistance when such changes can be definitely synchronized with an alternating current. These depend for their action upon the rectification produced when an alternating current is passed through a conductor in phase with a change in its resistance. The sensitivity is such that under favorable conditions it is possible to detect a cyclic change no larger than a hundred-millionth part, and the selectivity is such that a change in resistance of the same frequency as that of the test current can be measured while there are other changes which may be a thousand or even a million times larger. Since the required apparatus is fairly simple, the methods may have a number of scientific and technical applications.—*Bureau of Standards, Washington, D. C.*

Stacks and Flues, Design Data for

In order to obtain data as to the temperature and the gas volume at different points throughout the height of the stack and the velocities at different points of the cross-section, one of our new stacks is being equipped at the present time with thermocouples and with gas-analysis pipes at several elevations. At Purdue University a stack of somewhat similar dimensions is in the course of erection for a boiler house. This stack will be equipped with platforms at various elevations, enabling experiments of different kinds to be undertaken.—*New Bedford (Conn.) Gas & Edison Light Company.*

Suggestions for Research

Dielectrics, Solid, Mechanical Stresses in

When two wires are sealed in glass, there is a tendency for the glass to crack when a difference of potential is applied between the wires (E. E. Schumacher, *American Chemical Society Journal*, 1924, Vol. 46, No. 8). This is an indication that dielectric stresses, or a resulting conduction current, cause mechanical stresses in the dielectric. This fact may serve as a starting point for a further study of solid dielectrics.

Magnetic Flux, Measurement of, Without Test Coil

One of the usual methods for measuring a magnetic flux is to place a secondary coil over the exciting winding and to connect it to a ballistic galvanometer. Sometimes the shape of the magnetic circuit precludes placing the test coil in a desired position; for example, in a cylindrical rotor of a high-speed alternator or in an iron-clad lifting magnet. For such cases Blondel and Carbenay have devised a bridge-type ballistic method with which a secondary coil is not necessary. See *Revue Générale de l'Electricité*, June 7, 1919, Vol. 5, page 812. It is thought that this method deserves to be more generally known among electrical investigators.

Metals, Electrolytic Precipitation of

Electrolytic refining of copper is an old process, but of late processes have been introduced for direct deposition of copper, zinc and iron from dissolved ores. A wide use of such an electrolytic process, in place of the usual pryo-metallurgical processes (smelting), would be of great practical importance and also another large field for electrical energy. At the present time the actual amount of the electrical energy required for precipitation is much in excess of the theoretical quantity, and considerable research will be required to reduce the losses due to impurities, the resistance of the electrolyte, counter-emf. of polarization, etc.

Neon Lamp

Applications for other than lighting purposes continue to be found for the neon lamp—in radio, in measurement of inductances and capacities and as a detector of leaks from high voltage insulators. For literature references see *Transactions of I. E. S.*, October, 1924, page 725.

Permeameter, Industrial Applications of

The principle involved in the "Simplex" permeameter seems capable of considerable practical expansion. It should be practicable to apply this potentiometer method to the testing of actual punchings of considerable width. This would mean no loss of material, and the results would include the effects of mechanical work. The measurement of magnetic potential drop by this method also offers possibilities in the testing of welds.—*Frank P. Fahy, New York City.*

News of the Industry

Muscle Shoals Opponents Resort to Filibuster

As this was written the conference report on the Muscle Shoals bill was, in company with other measures pending in the United States Senate, facing a filibuster. Senator Norris has the support of other members of the Upper House in delaying progress by persistent discussion of fertilizer production as well as of quite unrelated topics. The Nebraska Senator said on Wednesday that the report would lead to debate which might extend over two or three days, and he was not prepared to proceed. It was admitted that should the opponents of the bill muster enough strength to prevent a vote being taken this week the Senate might vote to withdraw the bill rather than sacrifice other legislation.

While the fertilizer industry is eager to see the Underwood bill killed, the interests of the power companies apparently would not be affected greatly by any action or lack of action on the part of the Senate. If the conference report is approved, it is expected that the power companies will renew their fertilizer offer. If the bill fails, they will have the opportunity to lease the power under the custodial authority of the Secretary of War.

Trade Commission Prepares for Power Investigation

The Federal Trade Commission is losing no time in beginning the investigation of the General Electric Company which has been ordered by the United States Senate. When the resolution was delivered to the commission on February 12 a meeting of the members was called and it was decided to refer the resolution to the commission's economic division, since the work was regarded as likely to be of a statistical and accounting character rather than of a legal nature. The commission called in its chief examiners. Schedules were arranged looking to the completion of the investigation in ample time for the commission to have its report ready for submission to Congress on December 1.

American Gas-Virginia Power Merger Consummated

Stockholders of the American Gas & Electric Company voted approval on February 17 of the merger by which, as already foreshadowed in the ELECTRICAL WORLD, the Virginia Power Company becomes one of the properties of the first-named corporation. This has been brought about by a consolidation of the Appalachian Securities Corporation, which had acquired the Virginia Power, with the American Gas & Electric. The new corporation will retain the latter name. The incorporators are S. Z. Mitchell, president of the Electric Bond & Share Company; Anson W. Burchard, vice-president of the General Electric Company, and R. E. Breed, president of the original American Gas & Electric Company. The new company is capitalized at 600,000 shares of preferred stock and 2,250,000 of no par common.

Pensacola Electric to Affiliate with Alabama Power

Announcement is made by Thomas W. Martin, president Alabama Power Company, that interests closely affiliated with that company have acquired the Pensacola (Fla.) Electric Company and that plans are under way for the extension of hydro-electric service from the Alabama company's system in south Alabama to Pensacola and other cities of north Florida. Plans are also being considered for transmission lines to coast cities of Mississippi and Alabama, he said.

The effect of the sale of the Pensacola Electric Company, it is believed, will be to make this company, along with companies recently acquired or about to be acquired at Mobile, Gulfport, Biloxi, Pass Christian and Bay St. Louis, an operating subsidiary of the Alabama Power Company. The development will provide hydro-electric power for the first time to ports on the Gulf Coast. The plans also contemplate, it is said, bringing such power for the first time to a rapidly growing agricultural and cotton section. The Alabama Power Company already is the center of the so-called Southern superpower zone.

The Pensacola Electric Company has been managed by Stone & Webster under a receivership, which is now terminated.

General Electric Men Withdraw from Bond & Share

At the annual meeting of the stockholders of the Electric Bond & Share Company held this week, the first meeting since the General Electric Company distributed its holdings of common stock of that company, all of the directors were re-elected except C. A. Coffin, E. W. Rice, Jr., O. D. Young, Anson W. Burchard and R. T. Paine, 2d, who, in connection with such distribution of stock, expressed their desire to withdraw from the board and not to be re-elected. In lieu of the General Electric Company directors five vice-presidents of the Electric Bond & Share Company were elected. The Board now consists of H. C. Abell, A. C. Bedford, S. Reading Bertron, Frederick A. Farrar, C. E. Groesbeck, E. K. Hall, E. W. Hill, Edwin G. Merrill, S. Z. Mitchell, F. B. Odlum, L. H. Parkhurst, Lewis E. Pierson, William C. Potter, Felix T. Rosen, F. Silliman, Jr., and Frederick Strauss.

Florence Lake Tunnel Is Driven Through

A telegram from the Southern California Edison Company to the ELECTRICAL WORLD announces that the Florence Lake Tunnel became a fact at 10.40 a.m. on Wednesday, February 18, when the two gangs of men blasting in opposite directions demolished the last thin barrier separating them. This 13¾-mile tunnel, the largest of its bore (15 ft.) in the world, was begun by the Southern California Edison Company in August, 1920, and has given employment day and night to 2,500 men, who have been exiled behind snow drifts every winter. It is driven through the solid granite of the Kaiser Ridge, in the Sierras above Fresno, and connects Florence Lake with Huntington Lake.

Sufficient water from the San Joaquin River can be diverted through the tunnel into Florence Lake to generate 1,000,000 hp. The project adds 30,000 acre-ft. of storage to the existing 89,000 acre-ft. in Huntington Lake for the operation of the chain of power plants on the Big Creek-San Joaquin development and is thought to assure an adequate water supply even in years of extreme drought. Work will now be pushed to make it possible to catch the 1925 spring run-off. The total cost of the tunnel is put at $17,000,000.

Injunction Against More San Joaquin Storage

After a hearing before the California Superior Court extending over six weeks the Herminghaus estate, which owns 18,000 acres of land on the lower San Joaquin River, has obtained an injunction which estops the Southern California Edison Company from constructing more storage reservoirs on the river. The plaintiff claimed that further storage would curtail its water rights.

The court held that the case hinged upon what could be considered a reasonable exercise of riparian rights. It could see no difference in principle between an actual diversion from the river of water not to be used on riparian lands and the impounding of the water over long periods by an upper riparian owner, the injury consisting in either case in preventing the water from flowing in its natural way, and the decision held that no argument could be advanced to justify the impounding and storing of the water as the defendant in this case contemplated doing, since such a use would be an unreasonable use.

An appeal to the Supreme Court of California is expected. Meantime construction work under way on the Big Creek project will not be affected, because further storage reservoirs are not essential to the work now in progress.

Western Power Corporation's Program

Ten-Year Schedule Involves Developing a Million Horsepower at Cost of $200,000,000—Wishons to Remain in Control of San Joaquin

FOLLOWING a visit to California of H. P. Wilson of New York, president of the Western Power Corporation, which recently, as reported in the ELECTRICAL WORLD, acquired the San Joaquin Light & Power Corporation, a statement has just been given out concerning the interconnection of the latter company's system with that of the Western Power Corporation's other California subsidiary, the Great Western Power Company, and the great scale of the expansion program contemplated. The plans call for the expenditure of more than $200,000,000 within ten years to develop 1,000,000 hp. on holdings on Kings River and the North Fork of the Feather River.

"This," said Mr. Wilson, "will be done by the expenditure of approximately $20,000,000 annually, but will probably run between $25,000,000, and $30,000,000 during 1925. The budget for this year calls for ordinary development work costing $7,000,000, special development work on power-house construction involving $15,000,000 to $20,000,000 and special construction work on the interconnecting system costing about $2,000,000." These projects will be financed through issues of bonds and preferred stock.

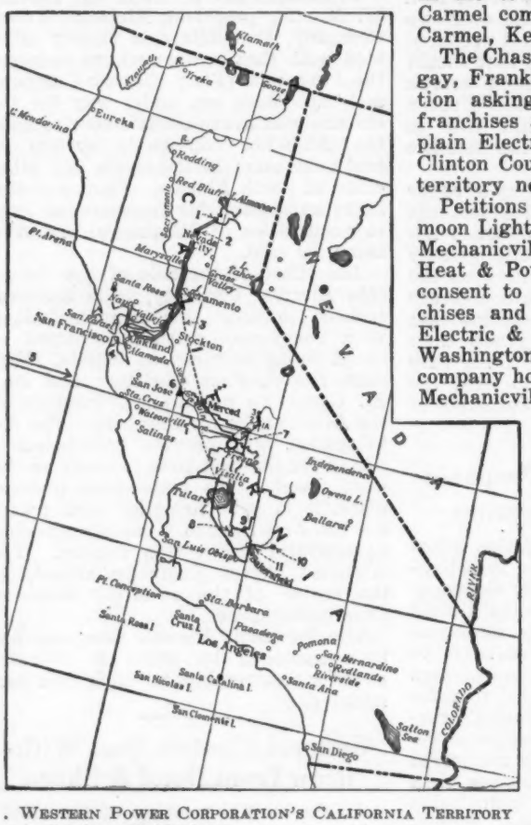
Though the plans are not yet definite, it is asserted that the interconnecting system will be about 100 miles long and may extend from Antioch on the north to Newman on the south. Work on the link will be started within a few months. "The acquisition of the San Joaquin Light & Power," Mr. Wilson declared, "was but the first step in building up a great system that will give California cheaper power and more efficient service. This step will undoubtedly be followed by others of equal or greater importance, but there is nothing sufficiently developed for me to make an announcement at this time."

WISHONS TO RETAIN MANAGEMENT OF SAN JOAQUIN

A. G. Wishon, vice-president and managing director of the San Joaquin Light & Power Corporation, was elected president at the annual meeting of the board of directors, in succession to W. G. Kerckhoff. A. Emory Wishon was made a vice-president and will also retain the post of general manager, assuming additional duties. Mr. Kerckhoff and A. C. Balch will continue as vice-presidents and with the two Wishons, Ben R. Meyer, A. B. Macbeth, H. J. Wilson, W. B. Joyce, W. B. Holmes and J. B. Black will form the new board.

"The acquisition of control of the San Joaquin Light & Power Corporation by the Western Power Corporation," Mr. Wilson said, "has no significance in so far as the conduct of the corporation is concerned. It is merely the change of ownership and control. The Western Power officials will come into the management only on broad questions affecting the industry as a whole. By acquiring control of the Great Western Power Company and the San Joaquin Light & Power Corporation it becomes possible to give added service and a wider distribution of energy throughout the territory served. The two systems are ideally situated for interconnection, and the load characteristics and potential possibilities of the territory served are such that the purchase was but a natural step in the ultimate development of the properties.

"Engineering studies are being made at the present time which will determine the future power-development program. There is sufficient installed capacity on the two systems to carry through the year 1925, but work will proceed on the raising of the Big Meadows Dam at Lake Almanor and upon the construction of a tie line between the two systems which will be designed for ultimate operation at 220 kv."



WESTERN POWER CORPORATION'S CALIFORNIA TERRITORY

1. Caribou, 66,000 kw.
2. Las Plumas, 65,000 kw.
3. Proposed 220-kv. interconnection.
4. Oakland, 10,500 kw.
5. North Beach, 16,000 kw. Great Western Power Company and Pacific Gas & Electric Company tied in at Oakland and San Francisco.
6. Point of tie with Pacific Gas & Electric Company.
7. Kerckhoff, 42,600 kw.
8. Midway, 25,000 kw.
9. Vestal, point of tie with Southern California Edison Company.
10. Kern Canyon, 10,600 kw.
11. Bakersfield, 26,550 kw.

In regard to rumors concerning the Eastern financial interests back of the merger of the two California utilities, Mr. Wilson said: "Neither the Byllesby Engineering & Management Corporation or the Electric Bond & Share Company has one dollar invested in the Western Power Corporation."

Many Mergers Are Under Way in New York State

The Carmel Light & Power Company of Carmel, Putnam County, N. Y., and the Cold Spring Light, Heat & Power Company of Cold Spring, also in Putnam County, have filed petitions with the New York Public Service Commission asking consent to the transfer of their franchises and property to the Harlem Valley Electric Corporation. The Cold Spring company's franchise is in the town of Phillipstown and the Carmel company's are in the towns of Carmel, Kent and Patterson.

The Chasm Power Company, Chateaugay, Franklin County, has filed a petition asking authority to transfer its franchises and property to the Champlain Electric Company of Champlain, Clinton County. Both companies serve territory near the Canadian border.

Petitions have been filed by the Halfmoon Light, Heat & Power Company of Mechanicville and the Salem Light, Heat & Power Company of Salem for consent to the transfer of their franchises and property to the Granville Electric & Gas Company of Granville, Washington County. The Halfmoon company holds franchises in the city of Mechanicville, the village of Stillwater and the towns of Stillwater, Halfmoon, Clifton Park, and Schaghticoke.

The Western New York Electric Company, Jamestown, asks authority to purchase the outstanding stock of the Carroll Electric Light & Power Company of Frewsburg. The Western company is planning to link the Carroll company's system with its own.

Petitions have been filed by the Windham Valley Electric Company of Windham, Greene County, and the Berholme Power Company of South New Berlin, Chenango County, asking for consent to transfer their franchises and property to the New York State Gas & Electric Corporation of Ithaca. The Windham Valley company is the owner of franchises in the towns of Ashland, Windham, Prattsville and Jewett. Its territory immediately adjoins that of the New York State company. The Berholme company serves the town of New Berlin and a portion of the town of Morris, Otsego County, and derives inadequate power from its hydro-electric plant at Holmesville on the Unadilla River.

Applications to transfer their franchises, works and systems to the Harlem Valley Electric Corporation of Rawling, Dutchess County, have been

filed by the Morgan & Wyman Electric Light & Power Company of Dover, the Lebanon Valley Lighting Company of Canaan and the Chatham Electric Light & Power Company of Chatham. These companies operate in the eastern section of the state near the Connecticut and Massachusetts state lines. A petition was also made by the Consumers' Electric Service Corporation, organized under the laws of Delaware, for permission to acquire and hold the capital stock of the Harlem Valley Electric Corporation.

Pinchot Takes Radical Stand

Indorsing Giant Power Survey, Pennsylvania Governor Favors Making Trunk Lines Common Carriers and Segregating Generation, Transmission and Distribution

GIFFORD PINCHOT, Governor of Pennsylvania, in submitting to the Legislature of that state the report of the Giant Power Survey which was authorized at his request by the Legislature of 1923 and of which Morris L. Cooke has been in charge, made recommendations for the stringent governmental control of the production of electricity through the Public Service Commission of Pennsylvania along radical lines indicated in the report itself.

The Governor envisaged a coming electrical era "when every household operation from heating and cooking to sweeping and sewing will be performed with the aid of electric power; when every article on the average man's breakfast table, every item of his clothing, every piece of his furniture, every tool of his trade, that he himself did not produce, will have been manufactured or transported by electric power; when the home, the farm and the factory will be electrically lighted, heated and operated; when from morning to night, from the cradle to the grave, electric service will enter at every moment and from every direction into the daily life of every man, woman and child in America."

If the present trend toward monopoly by electric utility companies all over the country is not soon checked, Mr. Pinchot said, the people in self-defense may be forced to public ownership of these utilities. He drew a distinction between "giant power," a tame elephant, "the friend and fellow-worker of man," and "superpower," a wild elephant, "at large and uncontrolled," which might prove a "dangerous enemy," and added: "The place for the public is on the neck of the elephant, guiding its movements, not on the ground, helpless under its knees."

Features of the Report

The report of the Giant Power Survey recommends among other things that all transmission lines rated at more than 50,000 volts be made common carriers, that generation, transmission and distribution be segregated under separate ownership, that "prudent investment" be the basis of valuations and that there be provision for consumers' mutual electric companies. Deputy Attorney-General Philip P. Wells has made the following elucidation of these plans viewed in their legal phase:

"To secure the economies of mass production in the generation of electricity for use in public service, together with the elimination of freight charges for long hauls of coal and the reduction of fuel cost by the distillation of byproducts instead of burning the raw coal, plants of great size (300,000 kw. and upward) should be placed at or near adequate coal deposits, and when feasible near sufficient supplies of condensing water either existing or capable of economical development. Sites meeting all these requirements are few. To this end 'giant power permits' should be issued by a permanent Giant Power Board (being essentially a matter of resources disposal).

"The giant power permittee should by incorporation be empowered to generate electric current and sell it at wholesale within the commonwealth to electric distribution companies and municipalities for use in public service; also to mine coal and to conduct a subsidiary business in coal, coke, gas, chemicals and other byproducts; also to exercise the right of eminent domain as noted below.

"Giant power permits should be limited to terms not longer than fifty years and the works should be subject, at the end of that period, to recapture by the commonwealth or a subsequent giant power permittee upon repayment of the capital prudently invested.

"The Giant Power Board should select, designate and acquire for the commonwealth by purchase or condemnation land strips of sufficient width and suitably placed for the location of giant power transmission lines. The right to use these strips for this purpose and for other public purposes such as gas pipe lines, oil pipe lines, etc., should be granted by the permit of the Giant Power Board. When such strips are not available, giant power permittees should have the right to take by eminent domain rights-of-way for their transmission lines.

"Lands servient to rights-of-way for railroads and highways should be made servient to use by high-tension transmission lines, including giant power transmission lines, subject to the approval of the Giant Power Board.

"To make sure that the energy generated by giant power plants is distributed on just and equal terms, regulated by the Public Service Commission and extended systematically throughout the state, all major transmission lines (of over 50,000 volts or 25,000 kw. capacity) must be common carriers. Therefore, the three businesses of generation, except by giant power plants and by small plants (of less than 25,000 kw. capacity), transmission and distribution (including minor generation and minor transmission), should be segregated in separate corporate ownerships.

"The principle of exclusive service territory now applied to distribution should therefore be extended to the segregated transmission business. The state should be divided by the Giant Power Board into transmission districts upon the basis of present facilities and future needs as they from time to time may be foreseen or arise.

"The rates of transmission and all conditions of the service should be regulated by the Public Service Commission.

"To extend electric service to regions otherwise not likely to get it, municipally owned and operated electric systems should be permitted to furnish service to unserved nearby territory at the direction of the Public Service Commission. The same rule should apply to companies chartered to serve incorporated places. Provision should be made for the incorporation of rural electric districts upon the favorable vote of a sufficient majority of inhabitants and of the owners of a sufficient majority of the acreage.

"Provision should also be made for the organization of consumers' mutual electric companies. All these should have an equal right with other distributing systems to purchase current from giant power and other generating companies for delivery by common-carrier transmission companies."

Governor's Comments

Governor Pinchot's own elaboration of the recommendations contains many interesting comments, including an expression of opposition to the regulation of interstate electric service as interstate commerce. "The report of the Giant Power Board," he says, "points out:

"First—Mass production, with opportunity for byproduct recovery. This is to be secured by giant power generating stations in or near coal fields supplying large-capacity transmission lines connecting with all other major transmission lines in the state.

"Second—The creation of a common pool of power into which current from all sources will be poured and out of which current for all uses may be taken. This is to be secured by making these giant power companies common purchasers of surplus power from all generating stations in the state and common sellers to all distributing systems in the state.

"Third—Free access by every water-power and steam-generating station to every potential purchaser, which means every distributing system in the state which supplies the consumer. This is to be secured by making all major transmission lines common carriers of current from the giant power companies and other generating stations to any and all distributing systems in the state.

"Fourth — Complete, prompt and effective regulation of rates, service and security issues. This is to be secured by fundamental changes in the public service company law providing chiefly for measuring the company's right to a fair return upon the stable and easily ascertainable basis of the money prudently invested instead of upon the unstable, slow and enormously costly process of valuation of the company's property as of each time the rate is fixed. The consent of the com-

panies to this new rate base should be required as a condition of every new charter, merger or exercise of the right to eminent domain. The commission should also have power to regulate security issues to correspond with the amount of prudent investment.

"Fifth—Rescue of the regulation of electric service from the destruction now threatened by its conversion into interstate commerce, which will be beyond the control of the states and has not been regulated by Congress. This is to be secured by compacts among the states consented to by Congress, as allowed by the Constitution of the United States, or failing that, by congressional legislation.

"Sixth—Systematic extension of service lines throughout the rural districts This is to be secured by farmers' mutual companies and by rural electric districts, each authorized to construct and operate distribution systems and each empowered to tax and borrow.

"Giant power," the Governor continues, "seeks the cheapest sources of power and hence the cheapest rates. It proposes to create, as it were, a great pool of power into which power from all sources will be poured and out of which power for all uses will be taken. It is the pooling of supply—not the disposal of surplus—and the chief idea behind it is not profit but the public welfare.

"Superpower, on the other hand, is the interchange of small quantities of surplus power at the ends of the distribution wires of each system. Its principal object is profit for the companies—not benefit for the public—and it is on the way to being realized with a rapidity which it is difficult fully to understand.

"The main object of the superpower idea is greater profit to the companies. The main object of the giant power idea is greater advantage to the people."

Separate bills providing for the sweeping changes in existing public utility laws outlined in the report will be introduced in the Assembly within the next few weeks.

Democratic Water-Power Bills Introduced at Albany

The Democratic water-power development bills were introduced in the New York Legislature this week. They are three in number and provide for a repeal of the Robinson law creating the Water Power Commission, for a repeal of the law of 1922 which authorized the Superintendent of Public Works among other things to expend a million dollars in the development of power from the surplus waters of the canalized Mohawk River at Crescent Dam and Vischer Ferry, and for the creation of a New York State Power Authority as recommended by Governor Smith. The last-mentioned measure carries an appropriation of $100,000 which the new commission would be expected to expend in making a survey of the power possibilities of the state on which to base a report to the Legislature of 1926. Since both houses of the New York Legislature have now Republican majorities, it is unlikely that the Democratic program will prevail.

Farmers Want Electricity

Conference at Washington Deals with Rural Situation—Hears Roseate Story from Ontario

INCREASED use of electricity on the farms of the United States to lighten the labors of the agriculturists and their wives and to increase efficiency was urged as one of the important elements in the solution of the farmers' economic problem at a conference on the "effects of motor and electric power on farmers" held at Washington February 17 under the auspices of the Farmers' National Council. Many of the delegates attending the meeting took the position that it would be better for the farmers if the power developed at Muscle Shoals were to be distributed throughout the surrounding country in the form of electrical energy, so that farms could be supplied with electricity, rather than to centralize the power for use in the production of fertilizer.

Use of electricity on the farms of the country has trebled in a period during which the proportion of agricultural workers has decreased from 65 per cent to less than 25 per cent, while agricultural production has remained the same per capita, the conference was told by C. D. Kinsman, agricultural engineer of the United States Department of Agriculture. He predicted increased use of electricity on the farms.

Judson King, director of the National Popular Government League, told the conference that private ownership is charging too much for electricity and painted a glowing picture of what he saw in the course of a drive "all over the eastern and central part of Ontario, visiting farm homes." Twenty thousand rural consumers are, he said, being served in 133 different townships, for whom 1,224 miles of distribution line has been constructed. The gain in 1924 alone in the farmer customers of the provincial hydro system, Mr. King asserted, was five thousand.

Edison Pioneers Meet and Show Menlo Park Memorial

Although Thomas A. Edison himself was at his winter home at Fort Myers, Fla., and therefore unable to be present, the Edison Pioneers met in New York on the Seventy-eighth anniversary of his birth on Wednesday of last week and held a luncheon celebration in his honor. Telegrams of congratulation and appreciation were exchanged. It was said to be the first time since the organization of the society, years ago, that Mr. Edison had been absent from the reunion. John W. Lieb, W. J. Hammer, J. W. Howell, F. A. Scheffler and William H. Meadowcroft were among the hundred Pioneers present. Charles L. Clarke, consulting engineer with the General Electric Company, was elected president of the society in succession to Charles L. Edgar.

The model for a memorial to Mr. Edison which is to be erected in Menlo Park, N. J., was displayed, and plans were formulated for an inaugural ceremony on or about May 16. John W. Lieb, chairman of the memorial committee, showed a bas relief in bronze of Mr. Edison's bust, which will be placed at the top of the bronze tablet, in the making of which, he said, there had been no attempt at idealization. The memorial grounds will cover seven lots at Lincoln Highway and Christy Street, Menlo Park. A parking space is to be reserved for tourists who may wish to stop and view the memorial. The tablet is to be placed on a huge boulder which will stand on a concrete foundation.

At Boston W. H. Atkins, general superintendent of the Edison Electric Illuminating Company, sent by radio a message which it was hoped Mr. Edison would pick up in Florida. After a tribute to the inventor Mr. Atkins said, addressing Mr. Edison directly:

"Although a possession of the whole world, Boston takes particular pride in claiming you as its son as it was here in our historic city that many of your earlier inventions were consummated. Thus it is particularly fitting that this message of felicitation should be sent from Boston and also from the broadcasting station of one of the earliest central stations organized to adopt your system and make use of your inventions."

Albert Emanuel Buys Cumberland County Company

Nearly all the common stock of the Cumberland County Power & Light Company of Portland, Me., the most important central-station property in that state, has been acquired by the Albert Emanuel Company of New York City under an offer made by it to the former stockholders of $136.50 a share. This company serves twenty-nine places in addition to Portland and sells wholesale to the Western Maine Power Company. It owns five hydro-electric generating stations with a total capacity of 22,750 kva. and a steam station at South Portland rated at 12,500 kva.

The Albert Emanuel Company operates and controls electric light and power companies in Iowa, Kansas, Ohio, South Dakota, Oklahoma, Indiana, Pennsylvania and West Virginia. This is its first entry into the New England field.

Utility Bills Before Connecticut Legislature

The judiciary committee of the Connecticut General Assembly considered two important bills relating to public utilities on Tuesday of this week—one to give the right of eminent domain to utility corporations, in support of which President Samuel Ferguson of the Connecticut Power Company and Hartford Electric Light Company appeared, and the other a bill to require the Public Utilities Commission to give hearings on all cases where discontinuance of service is intended. This measure Mr. Ferguson opposed.

"It is the users of electricity rather than the companies who will benefit if right-of-way 'hold-ups' are eliminated," Mr. Ferguson said. The requirement of hearings by the utility commission before service could be cut off would, he said, leave the commission no time for anything else.

California Co-operative Campaign Changes Name

A new plan of organization and a new name for the California Co-operative Campaign were decided upon unanimously at the regular meeting of the advisory committee held at Del Monte on February 1. "California Electrical Bureau" was the name chosen, and under this title the activities of the old Co-operative Campaign association will be carried on in the future, but with a broader scope. Wherever the name of the bureau appears the words "educational-promotional" will be used to define the nature of its work.

Under the new plan all retailers and wholesalers in electrical supplies will be invited to participate in the activities of the bureau, and such new units will have representation on the advisory board. Other important changes made were outlining the work of the bureau for a three-year period in the interest of continuity and the pledging of financial support on a three-year basis so far as possible.

S. E. D. Again Sponsors Camp Co-operation

The annual meeting of the Society for Electrical Development was held at New York on February 3, Vice-president James R. Strong presiding. The following directors were elected for a term of four years each to represent their respective groups: Central stations, John F. Gilchrist; manufacturers, George F. Morrison; jobbers, F. D. Van Winkle; contractor-dealers, G. F. Laube.

The society will again sponsor the conference of representatives of local co-operative electrical organizations to be held at Association Island, Henderson Harbor, N. Y., from September 8 to 12. It will be known as Camp Co-operation V, and the business program will be drawn up by the League Council appointed at last year's conference.

Electrical leagues have been formed in Galesburg, Ill., and Camden, N. J., and the home-lighting contest committee of Binghamton, Endicott and Johnson City, N. Y., is being continued as an interim organization until the necessary plans can be worked out for the formation of a league.

"Managing Director" for Electric Railway Industry

Lucius S. Storrs, New Haven, Conn., was named "managing director" of the electric railway industry at a meeting of the executive committee of the American Electric Railway Association last Monday. The position is a new one, created to make available to street-car and interurban managements the services of a widely experienced transportation executive. Mr. Storrs, who will retire on April 1 from the presidency of the Connecticut Company, was, it is announced, selected for his important new post by an advisory council including Owen D. Young, Guy E. Tripp, Samuel Insull, B. C. Cobb and Randal Morgan. He will have his headquarters in New York and is to have as a council to aid him H. G. Bradlee, Nicholas F. Brady, Britton I. Budd, F. R. Coates, Samuel M. Curwen, Frank L. Dame, Henry L. Doherty, C. D. Emmons, P. H. Gadsden, Thomas N. McCarter, S. Z. Mitchell, J. H. Pardee, H. H. Porter, Paul Shoup, R. P. Stevens, A. W. Thompson and J. N. Shannahan, president of the railway association.

Interconnection Helps Vermont Hydro Plants

In contrast with the hampered power production caused by low water in Maine recently, as noted in these columns, was the experience of hydro-electric plants in Vermont. Here the reservoirs were just as low as in Maine and a thaw was anxiously awaited, but the Vermont Hydro-Electric Company, whose headquarters are at Rutland, was able to take good care of the situation because the interconnected lines of the New England Power Company brought it electrical energy from as far south as Providence, R. I.

The Vermont company supplies power to a belt running across the state, serving approximately 250 square miles of territory and a population of about 100,000 people in seventy-five communities. To maintain its service while the low water prevailed it purchased from the New England Power Company in January about a million kilowatt-hours, or one-third of its total output for that month. An auxiliary steam plant is being installed at Rutland which will in future reduce the amount of power it has been necessary to buy from the interconnected company every winter—an amount that was this year greater than ever before. In the meantime Chief Engineer N. D. Holmes of the Davis Bridge hydro-electric plant of the New England company, in sending to the ELECTRICAL WORLD a newspaper story of how the Rutland company met the emergency, points the moral of the reliable interconnected plant and the helpless isolated one when local power fails.

Public Utility Bills in Indiana Legislature

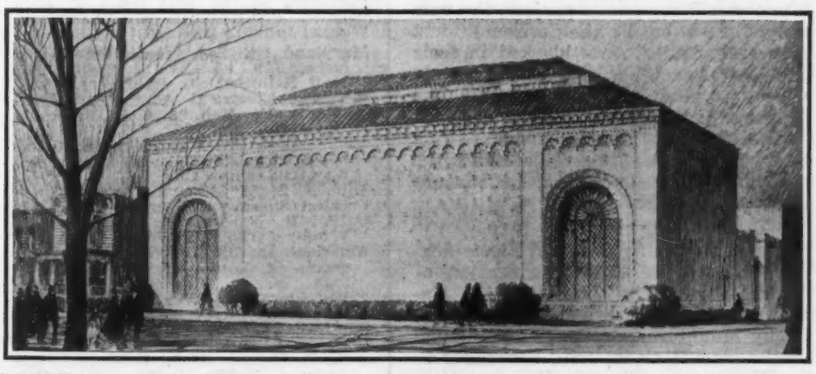
Public utility companies continue to be an object of lively interest to the members of the Indiana State Legislature. Several measures have been rejected, and others have been introduced.

Falling one vote short of the required constitutional majority, the Barker bill in the Senate to prevent utilities with indeterminate licenses from appealing rate case decisions from the commission to a federal court before carrying the appeal through all state courts failed, though it may be called up again. In the House the same bill was defeated without a division.

The Senate has passed unanimously a bill which requires utilities to keep within the state all books and accounts relating to the utilities' operation. The measure was approved by the Public Service Commission. It also prohibits any person from becoming a director in a utility unless he is a bona fide owner of common stock.

Representative Charles Mendenhall has withdrawn his bill to define the fair value or the rate base of a public utility corporation as the last value of the property assessed for tax purposes by the State Board of Tax Commissioners plus the cash betterments and capital additions made since the time of that valuation. Mr. Mendenhall introduced the bill as a companion measure to one killed two days before which sought to increase the power of the Public Service Commission in the matter of the regulation of security issues by utility corporations and to prevent the over-capitalization of such corporations. One of the provisions of the first bill would have made it unlawful for the commission to authorize a utility to issue securities when the amount of the issue plus outstanding stocks, bonds, notes and other evidences of indebtedness would be in excess of the fair value of the property. This bill was killed by a vote of fifty-one to forty-two.

Brooklyn Edison to Build Ornamental City Substation



THE Brooklyn Edison Company, which last year acquired the electrical business of the Flatbush Gas Company, serving what is largely a superior residential section of the borough, has announced plans to build a substation in Flatbush near Erasmus Hall High School and other prominent buildings. This station is to present an attractive exterior appearance which will forestall any esthetic criticism. It will be in the Italian Renaissance style, using a combination of gray tapestry brick laid in old English or Dutch bond and trimmed with glazed white terra cotta with blue background. The roof will be of a sloping type, topped with red tile. A brick wall about 20 ft. high will screen the four 10,000-kva. outdoor transformers.

Briefer News

Mobridge Electric Company Expands.—L. P. Runkel recently purchased the Mobridge Electric Company, Mobridge, S. D., and has added the towns of Selby and Eureka. The reported consideration for the Eureka property was $45,000.

North Carolina Companies Merge.—The Carolina Power & Light Company of Raleigh, N. C., has purchased the properties of the North State Power Company of the same city, which has served ten towns in Wake, Harnett and Johnston Counties, and will extend its lines to two others. The Electric Bond & Share Company of New York is the fiscal agent of the Carolina Power & Light.

Ottawa River Development.—At the opening of the Ontario Legislature on February 10 Premier Ferguson announced a government decision to go ahead with power development on the Ottawa River. There are two points there, he said, where 100,000 hp. can be produced quite easily. The Premier once more declared that the government would continue by every means possible to get the St. Lawrence development started.

Spartanburg to Have Two-Million Dollar Substation.—The W. S. Barstow Management Association will begin work within the next month on the construction of a two-million-dollar substation at East Spartanburg, S. C., for the South Carolina Gas & Electric Company. The new station will replace a small one now being operated at that point and will be linked with the 15,000-kw. steam plant now being built at Parr Shoals, between Spartanburg and Columbia.

Municipal Plant on Wynooche River Not Helped by Washington Legislature.—Citizens of Aberdeen, Wash., who two years ago voted $2,000,000 for the Wynooche River power project, the vote being thrown out by the Supreme Court on a technicality, were blocked in their efforts to have the Legislature now in session validate the election. The Senate committee on municipal corporations refused to consider the matter as emergency legislation. This leaves the bill in the air until the Legislature meets again in November.

Canadian Pacific Railroad Electrification.—A step in the electrification of the most westerly section of the Canadian Pacific Railroad through the Rocky Mountains and British Columbia to the Pacific Coast will, according to the Vancouver (B. C.) *Morning Sun*, be taken this year. The first stage of electrification will be the mountain section from Calgary, Alberta, to Revelstoke, British Columbia, a distance of approximately 200 miles. Hydro-electric power, the paper says, is to be generated at Surprise Rapids in the Columbia River north of Golden, British Columbia, and about 18 miles from the main line of the railroad. A dam across the rapids will cause the formation of a lake 20 miles in length, and the power development is estimated at 37,000 hp. Substations will be erected at intervals of about 30 miles along the railroad. The cost of this first step is put at $20,000,000.

Danville (Ill.) Central Station to Be Enlarged.—A million dollars approximately will be spent in the near future in enlarging the Danville plant of the Illinois Power & Light Corporation. Its present generating capacity of 19,400 kva. will be about doubled. Danville will be the eastern starting point on the high-tension steel-tower line that the company is building across central Illinois, which will interconnect Danville, Urbana, Champaign, Decatur, Bloomington, Peoria and Springfield.

Two Indiana Companies Merge.—A merger of the Indiana & Michigan Electric Company of South Bend, Ind., and the Twin Branch Power Company of Mishawaka, Ind., is under way. The Indiana & Michigan company does an extensive electric power and light business in northern Indiana and southwestern Michigan. The new company will acquire a steam generating station which is being constructed by the Twin Branch Power Company. The American Gas & Electric Company owns the present companies and will control the new company.

Bill to Promote City Ownership in Milwaukee Before State Legislature.—With the idea of placing Milwaukee in a position to acquire eventually the street railway, light and power properties of the Milwaukee Electric Railway & Light Company, a bill for amendment of the state constitution is before the Wisconsin Legislature. It provides for raising the bonded debt limit of Milwaukee from 5 per cent to 10 per cent of its assessed valuation, the difference to be used solely for municipal acquisition and operation of these utilities. Alex Ruffing of Milwaukee is author of the measure.

Wisconsin Valley Electric Company Adds New Plant.—With the placing in operation of the Alexander Dam power plant, 5½ miles north of Merrill, the Wisconsin Valley Electric Company has added another link to its chain of water-power plants along the Wisconsin River, bringing the number to six, in addition to undeveloped sites at Pine River, Bill Cross Rapids and Grandfather Falls. The central location of the Alexander Dam permits energy to be transmitted north to the properties at Tomhawk and Rhinelander or south to Merrill, Stevens Point, Wausau and other communities. The plant is automatic and it will develop 5,600 hp., bringing the generating capacity of the Wisconsin River plants to 20,000 hp.

Projected Ten-Million-Dollar Plant on Osage River.—Walter Gravens, president of the Kansas City (Mo.) Joint Stock Land Bank, has been elected president of the Missouri Hydro-Electric Company, which has been organized to build a ten-million-dollar water-power plant on the Osage River near Bagnell, Mo. A preliminary permit from the Federal Power Commission has been obtained. The plant will occupy almost the geographical center of the state, being 7 miles up the Osage River from Bagnell in Miller County. The plans include a dam which will back up the river for nearly 100 miles with an average width of one mile.

Edison Lighting Institute Dedicated at Harrison, N. J.—The Edison Lighting Institute, at which may be seen exhibits showing the development of electric light from its beginning in 1879, and which is designed to be a laboratory and a bureau of standards for the industry, was dedicated last week at the Edison Lamp Works in Harrison, N. J. There was a luncheon before the exercises, at which Anson W. Burchard, vice-president of the General Electric Company, presided. He gave a gold key to the institute to Frank W. Smith, vice-president of the United Electric Light & Power Company, who dedicated the building. Many prominent representatives of the electrical industry were present.

Mexico Wants to Link Colorado Problem with That of Rio Grande.—Official opinion in Washington is said to be divided as to the best course to pursue in the matter of the international aspects of the development of the Colorado and Rio Grande Rivers. The Minister of Foreign Relations for Mexico has issued a statement to the effect that Mexico does not desire to consider alone the equitable distribution of the waters of the Rio Grande and would like to consider that question in conjunction with the distribution of the waters of the Colorado. The fact that Mexico controls important tributaries of the Rio Grande just as the United States controls tributaries of the Colorado is a factor in the situation.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see ELECTRICAL WORLD, January 3, page 76.]

Maryland Utilities Association—Baltimore, Feb. 24. W. E. Smith, 107 East Redwood St., Baltimore.

Vermont Electrical Association—Burlington, Vt., Feb. 26. A. W. Peterson, St. Albans, Vt.

Oklahoma Utilities Association—Oklahoma City, March 10-12. E. F. McKay, Oklahoma City.

Illinois State Electric Association—Hotel Sherman, Chicago, March 18-19. R. V. Prather, Illinois Mine Workers' Bldg., Springfield, Ill.

American Institute of Electrical Engineers—St. Louis, April 13-17; Saratoga, N. Y., June 22-26. F. L. Hutchinson, 33 West 39th St., New York.

Southwestern Division, N. E. L. A.—Eastman Hotel, Hot Springs, Ark., April 21-24. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Arkansas Utilities Association, Hot Springs, Ark., April 21-24. R. I. Brown, Arkansas Central Power Co., Hot Springs, Ark.

American Electrochemical Society—Niagara Falls, N. Y., April 23-25. C. G. Fink, Columbia University, New York.

Southwestern Public Service Association—Rice Hotel, Houston, Tex., May 5-8. E. N. Willis, 403 Slaughter Bldg., Dallas.

Danbury, Conn., May Buy Franchise of Local Utility Company.—The city of Danbury, Conn., has under consideration the purchase of the electric and gas franchise of the Danbury & Bethel Gas & Electric Light Company, a Doherty property. The resolution was first read a year ago in the Council, and the second required reading has been tabled until March. If then approved, it will be referred to the citizens for ratification. The resolution was tabled in order to consider a proposed reduction of rates. Coupled with the announcement of a lower rate was the information that the reduced rate would not be effective if the resolution was adopted.

Lectures on Electric Trucks.—The lecture course on the electric truck held in the auditorium of the New York Edison Company, Fifteenth Street and Irving Place, will this year comprise nine lectures covering charging equipment, motors and controls, maintenance and repairs, fleet operation, how to get the greatest mileage, lubrication, transportation problems, garage management and a general talk. The first two lectures have already been given. Dates of the remaining seven are February 27, March 11 and 25, April 8 and 22 and May 6 and 13, at 8 p.m.

Washington State Committee on Farm Electrification.—A committee on the relation of electricity to agriculture in the State of Washington was organized January 23 at Pullman, Wash. The committee is composed of eleven farmers together with representatives of banks, colleges, utilities and farm bureaus. Dr. E. O. Holland, president Washington State College, is chairman of the committee, and Dean Johnson, director of the Agricultural Experiment Station, is chairman of the executive committee. Other members of the executive committee are Dean Carpenter, Professor L. J. Smith, C. H. Orton, J. H. McCloskey, A. W. Leonard, president Puget Sound Power & Light Company, and D. L. Huntington, president Washington Water Power Company.

Institute to Help Inventors.—Establishment of the Inventors' International Institute, designed to pass upon the practicability of inventions and the possibility of obtaining patents for them, has just been announced. The organization will have an office at 15 Park Row, New York. Members of the institute's board of engineers will include Eustus H. Thompson, specialist on steam turbines; L. H. Thullen, holder of more than seventy-five patents on electric and steam automatic signals, and Guy D. Collier, authority on dynamic heating and ventilating systems, all of New York; W. S. Richhart, Fort Wayne, Ind., expert on power plants and substations, and Christian E. Brown, Newark, N. J., authority on electrical automatic signals. Mr. Thullen and Mr. Richhart are members of the A. I. E. E.

Chippewa Falls, Wis., Still Dallies with Municipal Project.—Following the recommendation of a committee, the City Council of Chippewa Falls, Wis., will submit to the voters at the spring election the scheme for the purchase of a dam site on the Chippewa River, where it is proposed to erect a municipal power plant to serve the city instead of the Northern States Power Company. The project, which would cost more than a million dollars, would be financed by a bond issue. This will be the second attempt to pass this proposal, the first one having been overwhelmingly defeated last year.

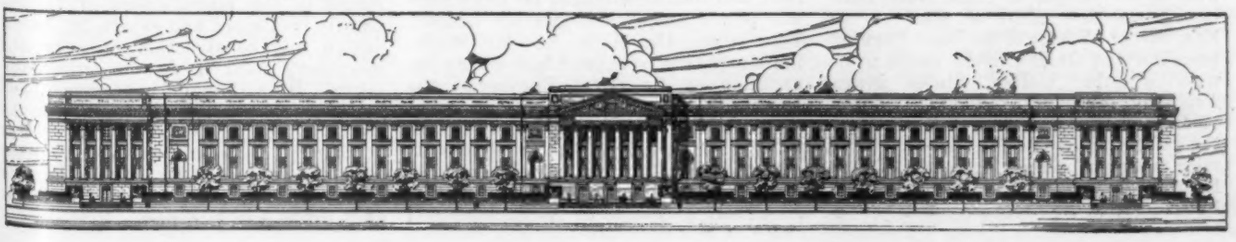
Record of Eclipse Observations in Metropolitan District.—"Observations of the Total Solar Eclipse of January 24, 1925, Made by Electric Companies Affiliated with the Consolidated Gas Company of New York" is the title of a well-gotten-up publication of forty-two pages issued, with a foreword by Vice-president John W. Lieb, under the direction of a committee of which Clarence L. Law was chairman. The book contains both separate and combined load diagrams showing the influence of the eclipse on the operations of the eight affiliated companies. Maps of the territory where the observations were made, photographs of the heavens and unusually interesting letterpress are included.

National Museum of Engineering and Industry.—Here is shown the design of the five-million-dollar National Museum of Engineering and Industry to be erected on the Smithsonian Institution grounds at Washington as a companion building to the natural history museum and the gallery of fine arts. The new museum will house exhibits depicting the dramatic evolution of engineering and the industries and will be the first national institution in this country devoted exclusively to recording industrial progress. It will be 1,150 ft. long, 250 ft. deep and cover twenty-seven acres of floor space. The great central rotunda will house a hall of fame for eminent engineers, inventors and industrialists and a founders' room to commemorate those who will have contributed to the museum in time, money or effort. A public building and endowment fund of $10,000,000 is being raised from the present headquarters of the National Museum of Engineering and Industry in the Engineering Societies Building, 29 West Thirty-ninth Street, New York City.

Prepare for Rural Service Extension in Ohio.—At a conference of representatives of the National Electric Light Association, the College of Agriculture of the Ohio State University, the College of Engineering and representative farmers held February 5 at Columbus, Ohio, a committee on organization for rural electric development was appointed with the following members: Dean Vivian of the College of Agriculture, Ohio State University; J. B. Johnson, Elyria, representing the light and power companies; L. B. Palmer, president of the Farm Bureau; H. A. Caton, representing the Grange, and G. E. Reiff of the Allis-Chalmers Company, representing the manufacturers. This committee will meet on February 28, at which time a complete program will be presented for study.

Fight for Maryland Territory Adjusted.—According to an announcement by the Maryland Public Service Commission, territory in Carroll County for which five companies—the Consolidated Gas, Electric Light & Power Company of Baltimore, the Glen Rock Power Company (a Day & Zimmermann subsidiary), the Potomac-Edison Power Company of Hagerstown, the Maryland Public Service Company (a Barstow subsidiary) and the Consolidated Public Utilities Company of Westminster—had been contending will be awarded to the last-named. This will give it authority to build lines in the county which will extend within a mile of the terminals of lines belonging to other companies. The Hanover Power Company, which is controlled by the Barstow interests, is reported to have made a bid for the Westminster company's property.

Still Another Link in North Atlantic Interconnection.—The New York State Gas & Electric Corporation, whose headquarters are at Ithaca, N. Y., is to construct a 30-mile link of 110,000-volt line from Delhi to Liberty, N. Y., another of 15 miles from Cuddebackville to the New Jersey state line, and to raise the voltage of existing transmission lines between the two new links to form a continuous line from the Mohawk Valley to New Jersey. On the New Jersey border the line will be continued by the New York-New Jersey Superpower Connecting Company, a new concern, to connect with the system of the Public Service Electric & Gas Company near Paterson, N. J. This system, as announced, is to be tied in with the Staten Island Edison Company's system. This stretch will mean new construction of 20 miles. Only 65 miles of new lines are thus needed to complete the interconnection between the water power of western and northern New York and the Staten Island plants.



Men of the Industry

R. E. Lee Resigns

Rufus E. Lee, during whose presidency the Continental Gas & Electric Corporation has grown from a small public utility group into one of the larger organizations of its kind, recently announced his resignation as president, effective March 1. His successor will be Richard Schaddelee of Chicago. Mr. Lee's resignation follows the completion of a transaction whereby he and Cyrus S. Eaton of Cleveland and

R. E. Lee

their associates have sold control of the Continental to the United Light & Power Company of Chicago. Mr. Schaddelee, successor to Mr. Lee, is senior vice-president of the United company.

When Mr. Lee joined the Continental company as president three years ago, the company's properties included only the Nebraska Gas & Electric Company and the Iowa Service Company, serving a population of about 150,000. During Mr. Lee's presidency the Continental has acquired the Maryville Electric Light & Power Company, the Lincoln Gas & Electric Light Company, the Lee Electric Company, the Kansas City Power & Light Company and the Columbus (Ohio) Railway, Power & Light Company. The population now being served by Continental is in excess of one million. Mr. Lee was a pioneer in Nebraska's electrical development, having built the first electric system of Superior, in that state, in 1894.

W. E. Mitchell, formerly assistant general manager of the Alabama Power Company, was recently elected to the office of vice-president in charge of operation. This promotion was made by the directors in recognition of Mr. Mitchell's thirteen years of able service.

Donald C. King, formerly identified with E. H. Rollins & Sons, New York, has joined the editorial staff of the Electrical World in the New York office. Born at Omaha, Neb., and a graduate of the United States Naval Academy, Mr. King, following a period of four years in naval service, entered the public utility field as assistant district manager of the Continental Gas & Electric Corporation at Maryville, Mo. Subsequently he became manager of the South Side office of the Nebraska Power Company, Omaha, later affiliating himself with Rollins & Sons.

P. N. Bush Southern Editor of "Electrical World"

In order to augment its editorial service in the South, the Electrical World has appointed Philip N. Bush as Southern editor. Mr. Bush has been an engineer with the Alabama Power Company for the past year in connection with evaluation work and previously served with that company as a cost engineer during the construction of Mitchell Dam.

After his graduation from the University of Pennsylvania in 1914, Mr. Bush served in the World War as an aviator in the Lafayette Escadrille and then entered the test course of the General Electric Company at Schenectady. Later he was a salesman for the General Electric Company in Schenectady and in Detroit. Mr. Bush will assume his duties at Birmingham on March 15 and will cover the Southern States as a staff editor of the Electrical World. His acquaintance with the South and broad experience in the industry well qualify him for his new duties. He expects to visit all Southern properties and manufacturers soon.

David F. Houston, a director of the American Telephone & Telegraph Company and president of the Bell Telephone Securities Company, has been elected financial vice-president of the former organization, succeeding W. S. Gifford, recently elevated to the presidency. Mr. Houston spent eight years in President Wilson's Cabinet, first as Secretary of Agriculture and later as Secretary of the Treasury.

T. I. Jones Becomes Manufacturing Executive

T. I. Jones, formerly general sales agent of the Brooklyn Edison Company, has been appointed vice-president and general manager of the Radford Company, the Pneumelectric Corporation and the American Flexible Shaft Manufacturing Corporation, companies allied with the W. H. English interests, with headquarters in New York. The Radford Company is a new corporation manufacturing and selling electric portable lamps and electric specialties. The Pneumelectric Corporation is an older concern and manufactures and sells electric drills, hoists, pumps, etc. The American Flexible Shaft Manu-

T. I. Jones

facturing Corporation is engaged in the manufacture of flexible shafts. Mr. Jones' term of service with the Brooklyn Edison Company covered a period of sixteen years and followed a connection with the United Electric Light & Power Company, where he organized the sales department, becoming its first sales manager. He has been prominently identified with the activities of the National Electric Light Association, being a past-chairman of its Commercial Section and a member of several committees.

Obituary

Charles Henry Wordingham, well-known British electrical engineer, died on January 28 at Redhill, England, in his fifty-eighth year. Mr. Wordingham had been head of the electrical department of the British Admiralty from 1903 until just after the Armistice in 1918. When he went to the Admiralty in 1903 he became responsible for the electrical equipment of all ships of the British navy and for advising on electric light and power questions in the dockyards and other naval shore establishments. After his retirement he resumed practice as a consulting engineer and became engaged on large electric power supply schemes for Greater London and the Midlands. Mr. Wordingham was a past-president of the Institution of Electrical Engineers, the Incorporated Municipal Electrical Association and the Junior Institution of Engineers and president of the Illuminating Society. He was also a member of the main committee of the British Engineering Standards Association and chairman of the electrical sectional committee. He was one of the British representatives on the International Electrotechnical Commission, president and past-chairman of the British Electrical and Allied Industries Research Association and one of the founders of the Electrical Development Association as well as of the Society of Radiographers.

Charles M. Young, chief engineer of the Jeffery-Dewitt Insulator Company, Kenova, W. Va., died January 21 as the result of blood poisoning. Mr. Young was responsible for many improvements in the manufacture of Jeffery-Dewitt insulators and especially for the design and construction of automatic machinery used in forming the insulators. He also made improvements on machines for combined mechanical and electrical routine tests and many other permanent contributions to the success of this product. Mr. Young was a native of London, England, and was only thirty years of age.

Recent Court Decisions

Complaint Held to Charge Negligence in Failing to Insulate Wires. — Damages awarded to an employee (Hayes) who sued the Terre Haute, Indianapolis & Eastern Traction Company for injuries received from coming close to 23,000-volt wires while endeavoring to get a boy who had entered the high-tension room to leave it were sustained by the Supreme Court of Indiana. Failure to "insulate" the wires was charged, and the court held this to be a charge of negligence, defining "insulate" as meaning to place the wires in a detached condition or to prevent transfer of electricity by interposing non-conductors. Under the Indiana statutes, the court held, the suit could not be defended on the ground of assumed risk, contributory negligence or negligence of fellow-servant, and the employer having rejected the workmen's compensation act, the case was covered by the employers' liability act. (145 N. E. 569.)*

Grounds of Supreme Court's Decision Against Diversion of Lake Michigan Waters at Chicago.—The sustention by the United States Supreme Court of the injunction to prevent the withdrawal by the city of Chicago of water from Lake Michigan in excess of the amount permitted by law has already been noted in the news columns of the ELECTRICAL WORLD. Following is an excerpted recapitulation of the principles laid down as enunciated by Justice Holmes: "This is not a controversy between equals. The United States is asserting its sovereign power to regulate commerce and to control the navigable waters within its jurisdiction. It has a standing in this suit not only to remove obstruction to interstate and foreign commerce, the main ground, but also to carry out treaty obligations to a foreign power bordering upon some of the lakes concerned, and, it may be, also on the footing of an ultimate sovereign interest in the lakes. . . . The main ground is the authority of the United States to remove obstructions to interstate and foreign commerce. There is no question that this power is superior to that of the states to provide for the welfare or necessities of their inhabitants. . . . The defendant says that the United States has given its assent to all that has been done and that it is estopped to take the position that it now takes. A state cannot estop itself by grant or contract from the exercise of the police power. It would seem a strong thing to say that the United States is subject to narrower restrictions in matters of national and international concern. . . . Even if it had approved the very size and shape of the channel by act of Congress, it would not have compromised its right to control the amount of water to be drawn from Lake Michigan. It seems that a less amount than now passes through the canal would suffice for the connection which the United States has wished to establish and maintain. . . . The attempt to found a defence upon the foregoing licenses [issued by various Secretaries of War] is too futile to need reply. . . . The interest that the river states have in increasing the artificial flow from Lake Michigan is not a right, but merely a consideration that they may address to Congress, if they see fit, to induce a modification of the law. . . . Probably the dangers to which the city of Chicago will be subjected if the decree is carried out are exaggerated, but in any event we are not at liberty to consider them here as against the edict of a paramount power. The decree for an injunction as prayed is affirmed, to go into effect in sixty days—without prejudice to any permit that may be issued by the Secretary of War according to law." (45 S. C. R. 176.)

Scrapped Plant Properly Included in Valuation of Utility. — The Wisconsin Supreme Court has held, in Town of Milton vs. Railroad Commission, that where a public utility company found it more economical to scrap its power plant and obtain power from wires operated by an independent company, and could have recouped its loss through increased rates over a period of time, the value of the scrapped plant was a proper item to be considered in fixing the value of the entire utility on its sale to the town. Where part of the plant sold to a corporation was on land owned by the seller, and after transfer it was treated as land of the corporation and was so understood to be held by the public generally and the taxing authority, and was actually used and useful for the purposes of the utility, there was no error in the Railroad Commission's ruling that the town taking plant over as a public utility should purchase the land in question. (201 N. W. 381.)

Canadian Labor Act Found Unconstitutional.—An appeal by the Toronto Hydro-Electric Commission to the Privy Council in England with regard to the constitutionality of the industrial disputes investigation act (known as the Lemieux act) has been allowed. The appeal was the outcome of the appointment of a board of arbitrators to deal with a dispute between the electrical trades union of Toronto and the Toronto Hydro-Electric Commission. The commission claimed the industrial disputes investigation act was not within the powers of the Dominion Parliament, but the Appellate Division of the Supreme Court of Ontario ruled against this view, whereupon the Toronto Hydro-Electric Commission carried the case to the Privy Council, which constitutes for Canada a court of last resort. The Privy Council's judgment, as interpreted by the government, means that a large number of the conciliation boards which have derived their powers from the act, which has been in force since 1907, have functioned in an illegal manner, and the validity of their decisions is therefore destroyed.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Rate Increase Conditioned on Company's Refraining from Payment of Unearned Dividends.—The Porter Electric Line, serving fifty-eight rural customers, asked permission from the Wisconsin Railroad Commission to increase its line charge from $1.50 to $2 per meter per month. This permission was granted, subject, however, to an understanding that in the future no dividends shall be paid unless they have actually been earned, and further, that each year during the next five years the company shall set aside at least 50 per cent of its depreciation reserve provision in a fund which can readily be converted into cash. These restrictions were made because of the past practice of the company to declare an 8 per cent dividend whether earned or not. This practice resulted in producing deficits in its annual operating statements and in depleting its assets.

Full Reproduction Cost Not Allowable in Valuation of Inefficient Plant.—Establishing a reduced rate schedule for the Ely Light & Power Company, which had made a maximum charge of 17½ cents a kilowatt-hour, the Nevada Public Service Commission said: "The company is not entitled to the full reproduction new value of a plant which is so obviously inefficient and uneconomical as the plant of the defendant. . . . A utility is not entitled to earn what it may see fit to spend plus a reasonable return. A utility may consume all it can earn in operating expenses and the grounds for increase in rates through operating deficits will always be available. . . . We believe on the basis of the evidence before us that the consumers of defendant should be allowed at least 15 kw.-hr. under the minimum charge of $2 per meter per month, and an order will be entered requiring this change."

Underground Electric Service Not Obligatory.—A petition from residents of Princeton Street, Boston, asking that the commission order the Charlestown Gas & Electric Company to install underground electric service in that street was dismissed for lack of jurisdiction by the Massachusetts Department of Public Utilities, which said that it was powerless to make any order unless it appeared that the petitioners were aggrieved by the company's refusal or neglect to supply them with electricity. The commission said further: "Here there has been no refusal to supply the petitioners with electricity, nor any neglect. The petitioners' complaint is that the company is not prepared to furnish it in a particular manner desired by the petitioners. It appearing that the company is prepared to supply the petitioners adequately with electricity, we are of the opinion that we have no authority to order that it shall be supplied by means of underground service."

Manufacturing and Markets

Profit from Factory Visits

Contact Between Qualified Visitors and Factory Specialists Improves Relations

BY "OBSERVER"

FROM the early days of the electrical industry shop visits of customers—present and prospective—have been encouraged by progressive manufacturers. The value of closer contacts between buyer and seller, user and designer, is very well appreciated. In reality, the factory visit is so generally accepted as a regular practice that the chief point of interest in discussing it is the possibility of making it more profitable to both guests and hosts.

Where the reception and entertainment of visitors has developed into an organized undertaking, the danger often arises of making such occasions too perfunctory to be of much value. In the smaller plant a personal liaison is easy to establish between the staff specialists and the guests, and the number of visitors per party and per week is apt to be small enough to allow easy handling. In the large factory, entertaining perhaps one thousand visitors per year, the objective needs to be more carefully defined lest the visitor miss the staff members whom he most needs to see and spend his hours in a hurried tour of the property from the front gate to the most remote sprinkler head in the departmental stockroom, getting a first-hand idea of the size of the establishment but very little conception of its engineering resources.

MANUFACTURER TEMPTED TO HURRY VISIT

Progressive manufacturers are justly proud of their shops, and the temptation to lead the visitor on a stern chase from department to department is strong. Time seldom permits a searching session between the factory engineer and his guests on one of these industrial tours. Even if the visitor is sufficiently informed technically to discover interesting details of design or fabrication en route, the schedule too often forbids stopping to discuss anything intelligently. In too many cases a superficial view results.

Recently there has developed a tendency to raise the standard of factory guides in electrical shops and to define more clearly the objects of such visits. This is a step in the right direction. Group visits have their place, but the more concentrated survey in which the engineer from outside is brought in contact with the specialists who are working on his current problems and with the specific manufacturing processes and tests that bear upon them yields the maximum return to all concerned. While it is true that higher-salaried factory engineers have never been unwilling as a class to go into the shop with qualified visitors, these contacts are becoming a more normal part of factory life and time spent in this way is often richly repaid. The user of electrical apparatus needs to know more about the difficulties which the manufacturing engineer faces, and, conversely, the designer not infrequently is insufficiently acquainted with operating experience involving his apparatus.

Another type of shop visit which has begun to develop helpful thinking is the short convention meeting of purchaser groups at the factory to discuss the latest trends in apparatus design and application with the manufacturing engineers. One such meeting, perhaps a pioneer of its kind, comprised a group of some fifty electrical operating men from a geographic division of the N. E. L. A. in conference for two or three days with the factory engineers upon the subjects of high-voltage circuit breakers and relays. The factory engineers gave short talks upon the theories of line protection and of apparatus performance. With the operating men they discussed these subjects freely, and an earnest effort was made to bring out the "bugs" occurring in field service and to suggest remedies. Improved means of access to equipment interiors, facility of inspection and repairs, the adaptability of standard as compared with special designs, etc., were considered. In the course of the conference the group visited those portions of the factory devoted to work in these special lines. No attempt was made to cover the whole plant, and the tests which were "run off" bore directly upon the main topics of the meeting. Only the higher-grade engineers participated, and as a result the visitors obtained direct and authoritative answers to questions which the "office-boy" type of guide could not have handled. This sort of broadening contact between qualified visitors and factory specialists is certain to work far-reaching good both in industry relations and in the economic development of electrical apparatus to meet the stiff demands of quality performance at minimum cost.

National Distribution Conference Formulates Program

THE formulation of the program of activities of the National Distribution Conference marks the completion of the preliminary work of defining the task the conference has set for itself. The personnel of the six committees, each of which will deal with one of the six aspects of the problem of distribution, is now being selected and will soon be announced. Owen D. Young, chairman of the board of the General Electric Company, will, it is understood, be selected as chairman of the committee on the collection of business figures as a means toward accomplishing economies in distribution.

Secretary Hoover at the recent distribution conference (as reported in the ELECTRICAL WORLD of January 24) called attention to the fact that the greatest waste of all our economic system is the periodic inflationary boom and the consequent ensuing slump with all the speculation, unemployment and extravagance incident thereto. He further said that stability or instability in production and distribution is largely the result of the collective judgment of the trades and a right judgment cannot be formed unless they know the facts as to their own business and as to the trade as a whole. As a practical method of accomplishing the results outlined by Secretary Hoover, this committee will adopt the periodical collection of figures, first, covering quantities of a few selected commodities on hand, in the various stages of production, manufacture and distribution, and second, prices of the same commodities in the same stages for which quantities are collected. Other committees will cover various other phases such as trade relations, market analysis, advertising and advertising mediums, expenses and methods of doing business.

Chamber of Commerce to Vote on Taxation Policy

BUSINESS organizations making up the membership of the Chamber of Commerce of the United States have begun voting on a referendum to fix the chamber's attitude on three recommendations looking to reform in taxation methods. The propositions are put forward by a committee of the national chamber and if adopted by the membership will supplement a general taxation program to which the national chamber adheres as a result of earlier action. They deal with the imposition of inheritance or estate taxes and with co-ordination of federal and state taxation systems.

The specific proposals on which a vote is asked are: First, the federal government should always refrain from imposing estate or inheritance taxes; second, the estate tax now levied by the federal government should be repealed; third, there should be an organization of representatives of the states and of the federal government to co-ordinate national and state systems of taxation.

Waste in Sales Territories

THOUSANDS of dollars are unnecessarily spent each year in covering territory according to state boundaries instead of following lines of natural trade areas. How salesmen and organizations may increase income through the proper planning of sales territories is shown in a pamphlet entitled "Planning Salesmen's Territories," issued by the Domestic Commerce Division of the Department of Commerce. "Too many sales executives look upon the red line of a state or county boundary as a bunker which they do not dare to cross, thereby causing one

of the most widespread wastes in our distribution machinery," the bulletin continues. "If it costs from $30 to $50 per day to keep a good salesman on the road, it certainly pays the sales manager to consider most carefully the way to utilize his time to the best advantage." Yet this is what happens when territories are laid out with too little regard to transportation facilities and trade areas.

Not only the success of the sales department is involved in the proper planning of sales territories, but also the welfare and happiness of the salesman should be taken into consideration. The bulletin points out that some companies take great care to keep salesmen at work in territories where they may conveniently reach their homes. This also gives full play to the salesman's intimate knowledge of the territory in which he is living. An analysis of sales plans of a number of concerns has been made, showing that remarkable results have been achieved by careful and scientific methods of approach to the problem of properly routing salesmen. Numerous examples taken from actual practice have been cited to show how the country can be covered by salesmen who work their territories from some dominating city in which they live. The pamphlet includes a set of six plans to show the wide variety of sales territory plans actually in use.

Eliminating Speculation in Cross-Arms

Prices Based on Lumber Market at Time of Shipment—Orders Placed for Future Delivery with Price to Be Set at Shipment—Principle One Applied to Flour Milling

BY A LARGE PRODUCER

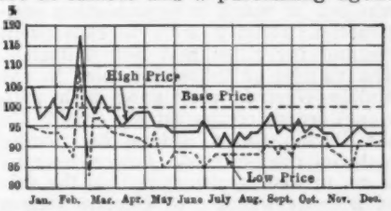
SPECULATION is not ordinarily thought of in connection with the purchase of equipment for transmission lines, and yet present methods of purchasing certain equipment entering into these lines have in them elements of speculation that work to the disadvantage of the industry. While this condition is here considered only in connection with the purchase of cross-arms, a movement on foot to eliminate it from this particular field serves as an excellent example of the method of attack in eliminating the element of speculation from other fields of central-station purchases.

The supply of cross-arms for electric pole lines is based on the lumber industry, which in turn is subject to certain important natural laws. The lumber for cross-arms cannot be grown as needed, but rather there exists a certain amount of timber suitable for cross-arm manufacture, and part of this timber is cut every year. The lumber used for cross-arms is of first quality and is such as may be easily utilized for furniture and housefurnishing, car flooring and related lines of manufacture. With a comparatively definite amount of this lumber cut every year, the proportion available for cross-arms is determined by the relative demand.

DEMAND FOR LUMBER FOR OTHER PURPOSES CONTROLS PRICE

Whether the lumber goes into cross-arms or other lines of industry depends entirely upon the price which is offered at the time the lumber is ready for shipment. If the demand for cross-arms is strong and the demand for high-quality lumber for other purposes is also good, there is competition between the two buying fields, with the result that the bulk of the lumber goes to that field which pays the highest price. Under such conditions it is of little use for a purchaser to come into the market and offer a lower price for the cross-arm lumber than can be obtained for the same material worked into other products. A low-priced offer results in no sale of lumber and no material for cross-arms. Stated briefly, the price of cross-arms rests, first, upon the price of lumber at the time the cross-arms are manufactured and, second, upon the cost of manufacture in the cross-arm plants. It may be asserted that the price of cross-arms is fixed by the market price of the lumber plus the actual manufacturing cost of an individual producer.

With the price fixed by the price of the lumber plus the cost of manufacture, and with the lumber price fixed by the law of supply and demand, it would appear that little could be gained by a purchasing agent trying to "beat the game." Take the case of a rising market in lumber and a purchasing agent



VARIATION IN PRICE OF DOUGLAS FIR (RAW MATERIAL FOR CROSS-ARMS) PREVAILING AT SEATTLE DURING 1924

who refuses to place orders for future shipments with prices to be fixed at the time of shipment, hoping that the price may weaken and that he may gain some advantage by delay. In such a case the purchaser may say that he will pay only so much for cross-arms for delivery in ninety days. If at the expiration of the ninety-day period the price of lumber has increased to the point where it cannot be manufactured into cross-arms at the purchaser's price, the producer cannot afford to buy the lumber at the increased price, and as a result the material goes to some manufacturer of other products who is willing to pay the market price.

The net result is that the bargain hunter finds there are no cross-arms available and that, if he wants the product at all, he must pay the price based upon the market price of the raw material. If the purchaser wishes to speculate on the market, he will find it necessary to purchase and stock the cross-arms himself as the manufacturer cannot afford to gamble on the lumber market. The stocks which the manufacturer can carry are only those to take care of variations in shipping orders from time to time and are not to take care of lumber market conditions.

ANALOGY IN FLOUR MILLING

A situation analogous to that outlined above exists in the flour-milling industry, and the method used to meet the situation in that industry may be of value in pointing the way to more stable conditions. Wheat, like lumber, is a natural product, and at a given time there is a very definite amount of raw material available or in sight. The market price of wheat depends upon the demand from the millers and the visible supply in the fields and elevators of the country. The flour-milling industry, which is absolutely dependent upon the wheat supply for its existence, long ago found that it could not afford to gamble on the future price of wheat in establishing a market for future delivery of flour. Any attempt to assume this risk immediately made grain speculation rather than flour milling the chief function of the miller.

As a result of this situation and a realization of the inability of the miller to perform the dual function of grain speculator and manufacturer, the milling industry years ago established the principle of basing the price of flour upon the market price of wheat at the date of shipment of the flour. The price of the flour was a definite amount above the cost of the wheat, and the difference represented the manufacturer's cost and margin of profit for transforming the raw material into the finished product. Under this system the miller who had the lowest manufacturing cost was always able to give the lowest price on the finished product, and a premium was placed on efficient manufacturing methods rather than upon speculating genius. This plan has worked so successfully for so long a time in an industry of such huge proportions that its wisdom cannot be questioned.

The methods in the flour-milling industry can be applied to the cross-arm industry with definite results. The working of the plan may be thus briefly stated: Orders for future delivery are placed immediately, the manufacturer provides for a production schedule to take care of the future shipments at the proper time, and the price of the finished cross-arms is based upon the market price of the lumber at the time the shipment is made. This plan does not call for any premature placing of orders, but only for the placing of orders for such material as is known will be needed by a given time. The essential feature of this plan here discussed is that the price to be charged for the completed product is to be established at the time shipping instructions are given and not upon the price existing at the time the order is placed. Under this arrangement the manufacturer is permitted to order his raw material on the basis of unfilled orders and to schedule the material through the mills, so that he is always able to supply the demand of his customers at the time his customers desire their

material and at a price only sufficiently greater than the market price of the lumber to cover cost of manufacture.

ADVANTAGES TO MANUFACTURER

Placing orders for future delivery at prices to be fixed at time of shipment has the following advantages for the manufacturer: (1) The producer is assured of a definite output for his factory and is able to schedule his production facilities to operate at the minimum expense; (2) the producer is relieved of the necessity of accumulating or reducing stock to take care of market fluctuations either real or anticipated; (3) in times of a rising market the producer is able to fill the orders of all his customers without having to watch his mills to see that they do not ship first the orders billed at higher prices and delay shipment on the orders on which loss will be sustained; (4) there is no temptation to "slip in" inferior grades of products to offset the loss incurred by a rise in the cost of raw material; (5) the producer is assured of a definite margin of profit above manufacturing and sales expense. He is, at the same time, obligated to keep these expenses to a minimum, for, if he does not, marginal producers of his product will enter the field and deprive him of some of his regular business; (6) the producer is relieved of the increased hazards of trying to follow market conditions and trying to protect himself by ample stocks or insurance against violent market fluctuations, the element of speculation being eliminated; (7) the producer is enabled to operate his mill on the most economical basis of production and thus actually reduce his selling price.

ADVANTAGES TO THE PURCHASER

Prices of finished products based on the cost of raw material plus the cost of manufacture have the following advantages for the purchaser:

(1) Orders for future delivery may be placed with the assurance that delivery will be made at the time specified and will not be delayed or canceled on account of any increase in price of raw materials; (2) the purchaser is assured of obtaining the best quality of material and need fear no substitution of cheaper material, as is sometimes practiced by irresponsible manufacturers and brokers, because of an increase in the market price; (3) the cost of finished products is reduced by the saving in overhead insurance which the manufacturer has had to carry to protect himself against the market fluctuations, and, finally, the purchasing agent is relieved of the responsibility of speculating on the lumber market in order to get the most favorable prices, as he cannot give much time to market speculation and still be able to serve the various departments in the selection of the proper and best type of equipment.

As will be noted, the advantages to the manufacturer and purchaser from the practice of basing cost of finished product on market price of raw material are quite interrelated, with the result that benefit to one party results in benefit to the other. Finally, this plan will have a very stabilizing effect on the entire cross-arm industry, with many intangible benefits that cannot be calculated in advance.

Business Conditions

INDUSTRIAL companies are maintaining their activity in the market and orders received, though none is of unusual size, are in slowly increasing volume. Central-station companies are active and are placing large inquiries as well as orders, especially for switching equipment. A sale has been announced by the Westinghouse Electric & Manufacturing Company of nearly $1,000,000 worth of turbo-generator equipment to the West Penn Power Company.

The Siemens-Schuckert Company, Berlin, Germany, has entered into a ten-year "patent, experience and practice" agreement with the Westinghouse Electric & Manufacturing Company whereby each company will benefit mutually from the research, inventive genius and electrical methods of the other. Rapidly growing lamp sales have caused the National Lamp Works of the General Electric Company to establish three new sales divisions with headquarters at Atlanta, Kansas City and Minneapolis. Steel operations continue active, but there has been some slowing up of current buying. Prices are holding firm, and it is believed that the present slackening is seasonal.

In New England central-station companies and industrial firms are figuring actively in the market, and the outlook is good. Industrial sales are improving gradually though slowly in the New York district, and central-station buying is in good volume. In the Southeast the expansion of the larger central-station properties, through the purchase of smaller plants, has resulted in much interconnection construction activity with a consequent demand for poles and line materials. The volume of industrial sales in the Middle West is very good with individual orders comparatively small. On the Pacific Coast orders for wiring material predominate. Power-company plans in that territory include the sale of a large number of electric ranges during the year.

Merchandising Sales Show Very Large Growth

THERE is a potential demand for electrical merchandise in the United States aggregating $130,000,000 to $135,000,000 a year, according to J. S. Tritle, manager of the merchandising department of the Westinghouse Electric & Manufacturing Company. In the two and three-quarter years that the merchandising department of the company has been established, Mr. Tritle said, the sales have increased from about $5,500,000 a year to between $11,500,000 and $13,000,000, as estimated for the fiscal year that ends next April.

Factory lighting, Mr. Tritle said, is increasing at the rate of 50 per cent a year; the growing use of the radio has stimulated the demand for battery chargers, and sales of electric flatirons constitute 33⅓ per cent of the total heating-appliance business of the country today. More than 40 per cent of the electric range business of the country is transacted by Westinghouse, said Mr. Tritle, and sales of both ranges and irons are showing a rapid increase. Merchandise sales of the company are expected to show an increase of more than 35 per cent in the next year.

Building Activity Continues at Very Good Rate

JANUARY building contracts in the thirty-six Eastern States amounted to $296,473,000, according to the F. W. Dodge Corporation, and building activity continues at a very good rate. This was a decrease of only 1 per cent from January of last year, which had the highest January building volume on record. There was also in January a decrease of 10 per cent from December, 1924. Nearly all districts showed a falling off from December, New York State and northern New Jersey and the Northwest States being the exceptions.

The Middle Atlantic States and the Central West showed decided decreases from January of last year, the other districts showing increases over the previous January. Last month's record included $127,231,900, or 43 per cent of all construction, for residential buildings; $67,372,000, or 23 per cent, for commercial buildings; $35,462,100, or 12 per cent, for public works and utilities; $19,454,400, or 6 per cent, for industrial buildings, and $15,338,600, or 5 per cent, for educational buildings. Contemplated new work reported in January amounted to $638,153,300. This was very large in proportion to the amount of contracts awarded, but it was 5 per cent less than the amount reported in January of last year. The volume of newly planned work reported is usually very high in January.

Appliances in Australia Charged for at a Power Rate

IT IS the almost universal practice in Australia to connect small appliances, such as electric flatirons, washing machines, fans, etc., on a separate circuit and to charge for the energy consumed by them at a power rate. This means that practically every house has two meters, one for lighting and one for domestic power, and it has not been found necessary for operating companies to indulge in publicity campaigns to push the sale of this particular class of goods as is usually done in America. The importation of the more expensive electrically operated appliances, like washing machines, is hampered by a heavy customs duty of approximately 45 per cent.

Outdoor switchgear and apparatus were recently for the first time adopted in Australia by the Osborne power station of the Adelaide Electric Supply Company. The power house generating equipment in this plant is of British manufacture, but practically the whole of the outdoor system and switchgear is of American make, despite the heavy customs duties that are levied.

Delinquent Electrical Accounts Again Higher in January

AN INCREASE in the number of delinquent electrical accounts for January, 1925, over December, 1924, is again reported by the National Electrical Credit Association, as shown in the accompanying table. The Philadelphia territory reported a decrease of nearly 3 per cent in the number of accounts for January, but the total amount and the average amount increased to more than double those of the previous month. The Pacific Coast territory was the only one that reported a decrease not only in the number of accounts but also in the total amount and the average amount.

DELINQUENT ACCOUNTS IN JANUARY

Branch and Month	Number of Accounts Reported	Total Amounts	Average Amount
Central Division:			
December, 1923	746	$92,731.23	$124.30
December, 1924	694	88,782.40	127.92
January, 1924	643	104,657.18	162.76
January, 1925	764	102,989.98	134.80
New York:			
December, 1923	344	42,943.00	125.00
December, 1924	303	40,897.00	135.00
January, 1924	248	40,799.00	164.00
January, 1925	308	42,186.00	137.00
Philadelphia:			
December, 1923	208	28,025.04	134.74
December, 1924	182	21,040.65	115.61
January, 1924	197	22,760.53	115.54
January, 1925	177	43,696.43	246.87
New England:			
December, 1923	36	4,176.85	116.02
December, 1924	50	*5,458.72	*109.17
January, 1924	28	3,948.95	141.03
January, 1925	65	6,577.12	101.18
Pacific Coast:			
December, 1923	17	1,791.96	105.40
December, 1924	29	4,495.06	155.00
January, 1924	19	1,896.43	99.81
January, 1925	22	2,775.57	126.16

* Note corrections on New England figures previously released for December, 1924.

Metal Markets Weak—Prices Lower—Demand for Lead Best

NO ORDERS of consequence have been placed by consumers in the non-ferrous metal market during the last week. Lower prices on the London market, unfavorable news from Europe and an unsteady stock market in New York have helped to create this condition. Speculatively held metal, together with that seeking a market through some of the custom smelters, is sufficient to establish the market at lower levels.

Offers of copper made Friday of last week for early delivery at 14⅜ cents produced occasional sales at that level, even into the second quarter. A fair tonnage of the metal offered on Tuesday found a buyer at 14⅛ cents for February-March delivery. The same price offered on Wednesday did not create any interest on the part of consumers. Most producers, however, are offering nothing at current levels, but are quoting 14⅜ to 15 cents and are confident that a large amount of buying for the second quarter will soon come. The foreign demand has been somewhat better than the domestic, but has not amounted to much at that.

The American Smelting & Refining Company reduced its official contract price for lead to 9¼ cents on February 13, and again on February 17 to 9¼ cents. The demand for lead has been better than for any of the other non-ferrous metals as consumers are bare of stocks, but they are buying only for immediate requirements and in small tonnages. Buying of zinc has been fairly good in the last two or three days, but not more than sufficient to absorb the offerings that are weakly held. Consumers remain indifferent to the tin market, only buying an occasional small lot at concessions. The price of tin has held up remarkably well considering conditions.

NEW YORK METAL MARKET PRICES

	Feb. 11, 1925 Cents per Pound	Feb. 18, 1925 Cents per Pound
Copper, electrolytic	14.85	14⅜
Lead, Am. S. & R. price	9¼	9¼
Antimony	20	21½
Nickel, ingot	31	31
Zinc, spot	7.75-7.80	7.75-7.80
Tin, Straits	57⅛	57
Aluminum, 98 to 99 per cent	28	28

Central-Station Orders Good in New York District

CENTRAL-STATION orders in the New York district are reported as being in good volume. They are largely for switching equipment. Many inquiries are being received this month for poles and cross-arms, and sales are said to be good. Many industrial firms formerly on part-time operation are now on full-time operation, and a large number of small orders are being received by manufacturers from this source. A steady, though slow, improvement in sales to industry is thus noted, and in one case industrial inquiries are said to be about 8 per cent higher than they were in the latter part of December. One company reports the sale of three 500-kva. transformers to a wire manufacturer, and in another case the sale of $50,000 worth of fractional-horsepower motors was made to an appliance manufacturer in central New York State.

Substantial supplies are expected to be purchased by steam railroads during the year, and present business is fair. Merchandise sales are good, and the prospects are that these will continue so. Lamp sales are also said to be very good. Jobbers report that slightly better business exists than there was two or three months ago, with a better sentiment among purchasers. The New York, Westchester & Boston Railroad has just announced its intention to extend its lines 1½ miles. Work on this will be begun this spring, the cost of which is estimated at $700,000.

Apparatus Moving Well in New England District

CENTRAL-STATION companies and industrial firms are figuring actively in the New England electrical market, and the outlook is good. A contract involving about $200,000 in generators, transformers and automatic switching apparatus has been awarded covering a 12,000-kva. hydro-electric installation to be built on the Farmington River in Connecticut for the Farmington River Power Company. A number of smaller waterwheel-driven generators have also been sold lately. A 19,500-hp. waterwheel unit has just been purchased for the Davis Bridge plant of the New England Power Company, the Lowell Electric Light Corporation has bought a 12,500-kw. steam turbine and the Baton Rouge Electric Company a 3,500-kw. steam unit. Two Massachusetts central-station syndicates have purchased forty carloads of fiber conduit, and line material is in fair demand. The woolen industry is entering the market more actively and textile and paper mills are ordering motors more freely, several $50,000 to $75,000 motor and supply orders being booked.

One electrical manufacturer reports the sale of 10,000 fractional-horsepower motors to a vacuum-cleaner maker and 1,000 washing-machine motors have also been ordered. A few small heat-treating electric furnace sales are reported from New Britain, Conn., and Boston. A 36-in. furnace has been purchased by a new Hampshire industrial plant and a 54-in. furnace by a Massachusetts hack-saw factory. The Waterbury (Conn.) Hospital has ordered thirty-two synchronous clocks. The demand for these is active in Hartford banking circles, and several recent sales have been made to radio broadcasters.

Jobbers report a temporary slackening in the demand for wiring material throughout New England, although a fair volume of business is being handled. Contractors are not rushed at present, but a good deal of new building is under way in central Connecticut.

Orders for Wiring Material Predominate on Pacific Coast

ORDERS for wiring material predominate at present over other classes of business on the Pacific Coast. The average quantity is markedly increasing, and buying, while cautious, has apparently passed the hand-to-mouth stage. Among the interesting orders are 200 assorted open-knife switches (externally operated switches being now standard), $1,000 worth of linen tape and other insulating material and 200 miles of No. 9 BB galvanized-iron wire. Export business is good, especially to Mexico, and several good orders have been reported from Alaska.

Power company business is still largely in the preparation stage, with some big requisitions. Close to 10,000 electric ranges are expected to be placed on California lines during this year, one company alone having set a quota of 5,000. Selling organizations and policies are now being perfected, but meanwhile there is an encouraging volume of inquiries. Motor business is very fair and within two months will have reached the peak of pumping-plant orders. The present excellent rainfall has replaced last year's drought, with the consequent urgent necessity for such installations. Increased selling effort and abundant power are expected to restore the balance. So far fan business has been very disappointing, signed contracts being few and advance orders still fewer. The recent price reductions on radio apparatus have stimulated sales.

The action of the lumber producers

in the Northwest in inaugurating a five-day week for a short time in the effort to curtail production and stabilize prices is being felt by all lines of business. Despite this the industry is optimistic and expects good business during the spring and summer. The Puget Sound Power & Light Company expects to sell 5,000 electric ranges during the year, and the city of Seattle's municipal lighting department sets its quota at 3,000. Initial range campaigns will be started in the Puget Sound district by the City on April 1.

Central-Station Construction Active in Southeast

THE outstanding feature of business in the Southeast is central-station activities. The expansion of the larger companies through the purchase of small properties and the construction of high-tension lines to such properties is serving to hold up the volume of pole and line-material sales. In these small centers the central-station companies are beginning to merchandise, with the result that jobbers' appliance sales are satisfactory. Several large orders for high-tension oil-switching equipment and high-tension transformers have been recently placed. Throughout Florida the demand for all lines is excellent, especially for ornamental street and highway lighting fixtures and ranges, and purchasing by central-station companies is a principal feature.

Electrical retail trade is considerably slackened on account of unseasonable and very inclement weather. Construction activities are below those of last January, and this is reflected in the falling off of orders for construction and wiring materials. There is no prospect, however, of a general slowing up in activities. Lamp sales are excellent and the volume is in excess of the same period last year.

Industrial Firms Increase Activity in Middle West

INCREASED activity in purchasing by industrial firms is noticeable in the Middle West. While individual orders of unusual size have been few and far between, the volume of business transacted has increased. Utility purchasing appears a trifle quiet, with a tendency toward conservative buying. One utility is in the market for approximately $150,000 worth of watt-hour meters, demand meters and current transformers, also a sizable quantity of current-limiting reactors. The demand for pole-line hardware has been excellent and a considerable demand has been noted for insulators.

Jobbers have experienced a satisfactory week. Building activity has accelerated their sales, while the number of inquiries for materials has increased. The city of Chicago is in the market for 50,000 lb. of weatherproof wire, 27,000 glass globes for srteet lamps and 15,000 porcelain insulators. Appliance sales remain good, with radio a little quiet. Prices remain firm, but have an upward tendency. Common steel-wire products advanced $2 per ton. Several minor changes in the prices of standard electric porcelain has been announced.

Activities of the Trade

American Resistor Company Opens New Branch Offices

The American Resistor Company, Milwaukee, manufacturer of non-metallic electric heating elements, including "Globar," announces the opening of branch offices at 46 Dey Street, New York City; 917 Packard Building, Philadelphia, and 802 Title Insurance Building, Los Angeles. The British Resistor Company, Aintree, Liverpool, England, and Kummler & Matter, Aarau, Switzerland, will also represent the American Resistor Company in their respective territories.

Westinghouse Gets Large Order for Power Equipment

The Westinghouse Electric & Manufacturing Company has received a contract from the West Penn Power Company, Pittsburgh, amounting to nearly $1,000,000, for power equipment. The order covers one 60,000-hp. turbo-generator and one 62,500-sq. ft. condenser. The unit is being built at the South Philadelphia works of the Westinghouse company and will be installed at the Springdale power house of the West Penn company. This is the fifth Westinghouse unit to be installed at this plant.

Hubbard & Company Hold Annual Sales Conference

The annual sales conference of Hubbard & Company, Pittsburgh, manufacturers of pole-line hardware and "Peirce" construction specialties, was held during the week of January 19 at Pittsburgh. Among the important questions discussed at the conference were the sales program for 1925, the company's policy, advertising and methods of helping the jobbers to increase their sales.

Those present included F. E. Norman, manager of specialty sales; F. E. Wright, district sales manager, New York; A. R. Robitzek, manager of hardware sales; F. M. Hughes, service manager; N. C. Husted, manager of the Niles plant; E. Wessel, district manager, Kansas City; R. G. Robbins, assistant advertising manager; H. C. Landsell, Chicago office; R. H. Manson, engineer; C. L. Peirce, Jr., manager; G. A. Green, statistician, and C. H. Keen, I. F. Wilder, M. M. Johnson, J. P. Spicer, A. McIlrath, R. O. Barnes, W. M. Heim, S. B. Webb and R. M. Waggoner, sales engineers.

States Company Secures International Representation

Arrangements have been concluded between the International General Electric Company, and the States Company, Hartford, Conn., manufacturer of central-station meter-testing apparatus and other specialties, whereby the International will represent the States company in substantially all foreign countries except New Zealand, Australia, Japan and Canada.

National Lamp Works Makes Changes in Its Sales Organization

To serve better the rapidly growing lamp territories the National Lamp Works of the General Electric Company announces that it will establish three new sales divisions. The new divisions will be the Southern lamp division with general offices at Atlanta, the Southwestern lamp division with general offices at Kansas City and the Northern lamp division with general offices at Minneapolis. General managers for these new sales divisions have not yet been appointed.

In the east central territory the Banner Electric Division at Youngstown, Ohio, and the Colonial Electric Division at Pittsburgh have been consolidated with the general office at Pittsburgh and will be known as the Allegheny Lamp Division, National Lamp works of General Electric Company. The company states that each of its sales divisions is qualified to give direct service on lamps and lighting and is under the guidance of a competent and experienced general manager and that back of this selling service are the engineering, research and merchandising resources of the National Lamp Works.

Westinghouse and Siemens-Schuckert Companies Enter Into Patent Agreement

THE Westinghouse Electric & Manufacturing Company and the Siemens-Schuckert Company, Germany have entered into a ten-year "patent, experience and practice" agreement whereby each company will benefit mutually from the research, inventive genius and electrical methods of the other. Max Haller, treasurer of the Siemens & Halske and the Siemens-Schuckert companies, and Dr. K. G. Frank, American representative of the Siemens interests, confirmed the agreement. Both Mr. Haller and Dr. Frank regarded the agreement as a very significant step in the economic development of post-war business relations between America and Germany.

Mr. Haller said that the Siemens companies have the greatest electrical research laboratory in Europe and that under the agreement its developments in electrical science are available to the Westinghouse company, as well as its experience and practice. The Siemens group recently obtained a loan of $10,000,000 in the American market which is being used for the development of its business, there being a large market for its products in Europe.

Dr. Frank, who recently returned

from Germany, said that nearly all factories were again operating, many of them at capacity, and that he had been impressed by the general industrial recovery. Dr. Frank also said that he believed the danger of a communistic upheaval had definitely passed and that he had noticed a distinct improvement in the relations between the Germans and French.

The Atwater-Kent Manufacturing Company, Philadelphia, manufacturer of radio equipment, will soon proceed with the erection of a second plant unit at its works at Wissahickon Avenue and Abbottsford Road. It will be one-story and basement, saw-tooth type, 198 ft. x 225 ft.

The Electric Tamper & Equipment Company, 11 South DesPlaines Street, Chicago, manufacturer of portable power plants and tie-tamping machines, has, according to Cornwall Jackson, general manager, plans under way for the establishment of a branch plant at Ludington, Mich., which will be used for experimental work and assembling purposes.

The Hyatt Roller Bearing Company, Harrison, N. J., has appointed P. C. Gunion, for six years advertising manager of the company, to a place on the sales board. Mr. Gunion will also be head of the market research activities in addition to his advertising work.

The Ideal Electric & Manufacturing Company, Mansfield, Ohio, manufacturer of direct-current and alternating-current motors and generators, announces that while representation has always been had in the Philadelphia territory, it is now opening its own office at 1234 Real Estate Trust Building, Philadelphia, in charge of A. M. Ross.

The International General Electric Company, which was reported in the ELECTRICAL WORLD of January 17 as having received an order for two 43,750-kva. turbo-generator units from Japan, also announces that the order includes two 1,000-kw., 3,300-volt, 50-cycle house turbines. The order was received from the Hayakawa Electric Power Company of Kawasaki, Japan, through Mitsui & Company.

The Hoover Company, North Canton, Ohio, manufacturer of vacuum cleaners, held the annual sales convention of the Southeastern division in Atlanta on February 9 and 10. District managers from the seven states of the division were in attendance. B. M. Meyer, manager of the Southeastern division, was in charge of the meeting. The principal speakers were E. C. Marine, R. C. Elliot and F. W. Buck.

The Radio Surplus Corporation, 18 Stuart Street, Boston, has recently been organized to buy from manufacturers, jobbers and dealers any surplus or complete stocks of merchandise they may wish to dispose of quickly even if they are discontinued or obsolete lines. J. G. Williams is head of the company.

The Alamo Corporation, successor to the Alamo Farm Light Company, Hillsdale, Mich., announces that it is now putting into production its new "Alamo" electric lighting unit known as the "type DB."

The Champion Switch Company, Buffalo, through its Southern representative, J. E. M. Mitchell, Atlanta, has just been awarded the contract to manufacture a total of 4,600 special indoor bus supports of 15,000-volt capacity for the Wilson Dam project at Muscle Shoals. All of these units are flat-base mounted with specially constructed porcelain insulators. **The Jeffery-Dewitt Insulator Company**, Kenova, W. Va., announces that it is manufacturing the special porcelain units that are to be used in connection with the above order.

The Connecticut Electric Manufacturing Company, Bridgeport, Conn., manufacturer of electrical specialties, has awarded a contract for the erection of a one-story addition to its local plant.

The Standard Turbine Corporation, Scio, N. Y., manufacturer of "Standard" turbines, turbo-generators, turbo-pumps and turbo-blowers, announces the appointment of Starkweather & Broadhurst, 79 Milk Street, as its Boston representatives. The company also announces the appointment of J. F. Shouse & Company, 70 Kenyon Building, Louisville, and Bradley T. Johnson, 708 Mutual Building, Richmond, Va., as its district representatives.

The States Company, Hartford, Conn., manufacturer of central-station meter-testing apparatus and other specialties, has appointed Howard N. Porter as sales manager, succeeding the late C. P. Upson. Mr. Porter was formerly advertising manager of the Automatic Refrigerating Company, Hartford, Conn.

New Equipment Available

Coal Crusher

The "Pennsylvania Armorframe" series of single-roll coal crushers for stoker coal preparation, crushing coal for pulverizers, gas-plant use, etc., and utilizing a steel-frame construction, have been placed on the market by the Pennsylvania Crusher Company, Stephen Girard Building, Philadelphia. Triple protection embodying a fabricated-steel-frame construction, heavy compression relief springs supporting the breaker plate and a special positive shear-pin safety device employing an ordinary steel bolt in hardened steel bushings prevent breakdowns caused by large iron in the feed.

Bethlehem section 30 in. I-beam girders form the side-frame construction of these crushers and cross-members of heavy channel and angle plate are hot-riveted to the girder-beam side frames to form the rigid unbreakable unit construction. A pivoted breaker plate which is readily adjustable to and from the crushing roll varies the size of product as needed from 1 in. to 6 in. The wearing parts are said to be all in plain sight and can be readily inspected.

Diesel Engines

A Diesel engine, known as the type Y and operating under a compression of 500 lb., has been placed on the market by Fairbanks, Morse & Company, Chicago. This unit replaces the company's former type Y, which was a lower-compression machine. The engine is built in ratings of 37½ hp. and 50 hp. for the single unit with multiples of these units for multi-cylinder machines. Tests made on this machine are said to show a fuel consumption of 0.42 lb. of 18,000 B.t.u. fuel oil per brake-horsepower at full rated load.

The fuel-injection system is of the same general design as used in the former engine with the exception that the pumps are grouped on a pump deck and inclosed in a case which serves as a fuel-oil reservoir. This change in design eliminates suction piping and permits of the fuel pumps being constantly submerged. This fuel-injection system, governor and the complete control of the engine centers in a unit mounted at the end of the engine. The lubricating system is entirely automatic and consists of a double lubricating oil pump and an outside filter.

Maximum Demand Attachment for Watt-Hour Meters

A maximum-demand attachment for use on its horizontal polyphase watt-hour meters has been developed by the Sangamo Electric Company, Springfield, Ill. This meter, which gives power-factor indications on balanced circuits in addition to energy measurements, will with the use of a maximum-demand attachment permit energy, kilowatt-demand and power-factor readings to be taken on the same meter. This demand attachment as well as the maximum-demand attachments for Sangamo single-phase and vertical polyphase watt-hour meters can also be supplied with a contact device which will ring a bell or give some other signal when the demand during any time interval reaches a certain predetermined value.

Hoist Starter.—A reversing starter, known as the CR-7009-M4, has been designed particularly for monorail hoist service by the General Electric Company. Its use is advocated on numerous other applications, as motor-operated doors, where economy of space is essential as it has been made small and compact. In operation this starter throws the motor directly on the line. It may be used with either alternating-current or direct-current motors and consists of four single-pole contactors mechanically interlocked, mounted on a suitable base and inclosed in a small sheet-metal inclosing case for wall mounting. A push-button station of the momentary contact type is provided for operating the contactors. The cover of the starter may be locked shut if desired.

New Trade Literature

METERS.—Bulletin No. 221 issued by the Bailey Meter Company, 2015 East Forty-sixth Street, Cleveland, describes the "Bailey" coal meter type "V6," which is designed to check the amount of coal delivered to each stoker in a boiler plant. Several illustrations are given showing typical installations in various plants.

LIGHTING DATA.—"Forty-five Years of Light" is the title of the twenty-ninth booklet of a series issued by the National Lamp Works, Publicity Department, Nela Park, Cleveland, Ohio, which deals with the history and development of the incandescent lamp. It discusses the part that modern research has played in the development and incidentally in the reduction of costs of the incandescent lamp.

CARBON CIRCUIT BREAKERS. — The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued circular No. 1,705, entitled "Westinghouse CL Carbon Circuit-Breakers for Industrial Applications." The circuit breakers are designed especially for 250-volt industrial applications where a compact breaker is required. A number of illustrations are given showing various applications of the breakers.

INDUSTRIAL LIGHTING—Bulletin No. 394 issued by the Holophane Glass Company, 342 Madison Avenue, New York City, entitled "Holophane Industrial Lighting," describes its industrial lighting units with specific application in a large variety of industries. It contains data on the various lighting units and a number of illustrations showing typical installations.

ELECTRICAL PORCELAIN.—The Federal Porcelain Company, Carey, Ohio, has issued a condensed catalog of standard electrical porcelain. It contains complete statistical data, including list prices, weights, dimensions, wire-carrying capacities, etc., on all the items of standard porcelain which are most commonly in demand.

ANCHORS.—The W. N. Matthews Corporation, St. Louis, has issued bulletin No. 800, describing and illustrating its "Scrulix" anchors. Instructions are given for installing the anchors with specifications of the various types. Attention is also called to other Matthews specialties, including its "fuswitches," disconnecting switches, slack puller, etc.

ADJUSTABLE CUTTER AND DRILL-PRESS CUTTER.—Paul W. Koch & Company, 19 South Wells Street, Chicago, is distributing a circular entitled "The Hole Story," in which it describes the "Jiffy" adjustable cutter and drill-press cutter, designed for the use of engineers, electricians and mechanics. Special knives are furnished for the adjustable cutter for cutting panels for switchboards up to 2½ in. thick.

ELECTRIC SANDER.—Barker & Company, 642 West Washington Boulevard, Chicago, are distributing a folder describing the "Barker" portable electric sander for finishing hardwoods and removing varnish from old work.

MOTOR-TRUCK WINCHES, CRANES AND DERRICKS.—Catalog No. 25 issued by the Mead-Morrison Manufacturing Company, East Boston, Mass., covers its motor-truck winches, cranes and derricks. Seven types of winches, a single-line truck crane and a pole-setting derrick are included in the Mead-Morrison line. All are easy to operate, rugged, compact and can be easily installed on any truck. The catalog contains several illustrations showing the trucks in action under various conditions such as installing transformers, cable-reel handling, stack setting, erecting transmission towers, etc. The company also manufactures tractors, grab buckets, gasoline and electric hoists, industrial handling equipment, etc.

Foreign Trade Opportunities

Purchase and agency is desired in Constantza, Rumania (No. 13,733), for electric light bulbs, chiefly 50 cp., and electric light accessories.

Purchase and agency is desired in Wellington, New Zealand (No. 13,729), for electrical household appliances, washing machines of centrifugal type and radio apparatus.

An agency is desired in Ottawa, Canada (No. 13,731), for porcelain goods, especially tubes and knobs.

An agency is desired in Prague, Czechoslovakia (No. 13,730), for radio sets and parts.

An agency is desired in Bordeaux, France (No. 13,732), for radio sets and parts and loud speakers.

Purchase is desired in Melbourne, Australia (No. 13,670), of electric traveling cranes of 15 tons capacity; (No. 13,672), of soot blowers.

Purchase is desired in Weltevreden, Java (No. 13,645), of pumps, steam shovels, excavators, concrete mixers, conveyors and pile drivers.

Purchase is desired in Dresden, Germany (No. 13,723), of dental apparatus and supplies and electrical machines.

TRANSFORMERS AND SWITCHING EQUIPMENT FOR THE FINNISH GOVERNMENT'S IMATRA WATER-POWER PROJECT.—A complete set of plans and specifications for transformers and switching equipment for the Finnish government's Imatra water-power station and several transformer stations has been received from Consul J. F. McGurk and is available for examination at the New York district office of the Bureau of Foreign and Domestic Commerce, 734 Custom House. Additional sets may be obtained from the Finnish Government Water Power Office, Helsingfors, Finland, for 800 Finnish marks (about $20) per set. Bids must be mailed on or before May 1.

SUBSTATION SWITCHGEAR EXTENSIONS FOR THE LAKE COLERIDGE (NEW ZEALAND) POWER SCHEME.—Tenders will be received by the Public Works Department, Wellington, New Zealand, until April 14 for substation switchgear extensions for the Lake Coleridge power scheme.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

GARDNER, MASS.—A petition has been presented to the City Council asking for the extension of the ornamental lighting system from Dunn's Driveway to Willow Street. The present cluster-lamp system is being replaced with single lamps of 600 cp.

SAUGUS, MASS.—The installation of an ornamental lighting system is under consideration by the town officials.

WEST HAVEN, CONN. — The United Illuminating Company, New Haven, has acquired a local site for a proposed substation, to cost about $25,000.

Middle Atlantic States

BINGHAMTON, N. Y.—The Public Service Commission has granted the Binghamton Light, Heat & Power Company permission to take over the property of the Messengerville Mutual Electric Company consisting of an electric transmission line through the towns of Marathon, Lapeer and Virgil to the village of Marathon. It also authorized the Binghamton company to extend its electric distribution to serve the town of Lapeer.

CAMDEN, N. Y.—The Niagara, Lockport & Ontario Power Company, Buffalo, has applied to the Public Service Commission for approval of a franchise granted to it by the Town Board and for permission to extend its transmission and distribution systems into the village to augment the supply of energy generated by the municipal electric plant.

ELMIRA, N. Y.—The Public Service Commission has authorized the Elmira Water, Light & Railroad Company to extend its electric distribution system in the towns of Hector and Lodi and has approved the franchises granted by the town boards.

LANCASTER, N. Y. — The Associated Gas & Electric Company, 61 Broadway, New York, has applied for permission to acquire a controlling interest in the Depew & Lancaster Light, Power & Conduit Company.

NEW YORK, N. Y.—The New York Edison Company has taken out a permit to erect a distributing station at 166-68 West Sixty-fourth Street, to cost about $100,000. William Whitehall, 709 Sixth Avenue, is architect.

NEW YORK, N. Y.—Bids will be received by the Superintendent of School Buildings, Board of Education, Flatbush Avenue Extension and Concord Street, Brooklyn, until March 2 for additions and alterations to the electrical equipment in Public Schools 5, 15, 31, 41, 44, 46, 73, 74, 78, 79, 88, 97, 101, 102, 110, 114, 115, 121, 132, 135, 150, 151, 169, DeWitt Clinton High School and High School of Commerce, Borough of Manhattan.

OGDENSBURG, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until March 4 for a fire-alarm system, etc., for St. Lawrence State Hospital, Ogdensburg.

RUSHFORD, N. Y.—The Genesee Valley Power Company, Fillmore, has applied to the Public Service Commission for permission to erect a distribution system in Rushford. The company proposes to extend its lines from Canada to furnish the service.

SCHUYLER, N. Y.—The Utica Gas & Electric Company, Utica, is considering the construction of a new power plant in Schuyler, to cost about $150,000.

WOODHAVEN, N. Y.—Bids will be received by the Superintendent of School Buildings, Board of Education, Flatbush Avenue Extension and Concord Street, Brooklyn, until March 4 for electric wiring and lighting fixtures, etc., for addition to Public School 65 on Seventy-seventh Street, near Jamaica Avenue, Woodhaven.

GARWOOD, N. J. — The Aeolian Company, 29 West Forty-second Street, New York, plans to install electric power equipment at its proposed plant addition for pipe-organ manufacture, to cost about $200,000.

OXFORD, N. J.—The Street Lighting District is planning to extend the lighting system from the Lackawanna Railroad station to lower Denmark.

SOUTH ORANGE, N. J.—The Board of Trustees is considering the installation of an improved lighting system on South Orange Avenue, Valley and Sloane Streets.

TRENTON, N. J.—The Trenton & Princeton Traction Company has been ordered to make improvements in its overhead feeder lines.

BETHLEHEM, PA.—The Holland Furnace Company, Holland, Mich., plans to install electric power equipment at its proposed local plant for the manufacture of furnaces and other heating equipment, to cost about $200,000.

HANOVER, PA.—The Maryland Public Service Commission has granted the Hanover (Pa.) Power Company permission to extend its transmission lines from the state line to Silver Run and Union Mills, a distance of about 5 miles.

JEANNETTE, PA.—The installation of a new lighting system on Clay Avenue is under consideration.

NORTHAMPTON, PA. — The Village Board has awarded a contract to the Pennsylvania Power & Light Company, Allentown, for the installation of an ornamental lighting system in the business district, to cost about $22,500.

PERKASIE, PA.—The Borough Council is considering extensions and improvements in the municipal electric power plant.

STEELTON, PA.—The Bethlehem Steel Company, Bethlehem, is considering the complete electrification of its local plant, to replacing all steam-operated equipment. The cost is estimated at $2,000,000.

CUMBERLAND, MD.—The N. & G. Taylor Company, 300 Chestnut Street, Philadelphia, contemplates installing electric power equipment in its proposed addition, to cost about $500,000.

WESTMINSTER, MD.—The Public Service Commission has granted the Consolidated Public Utilities Company permission to erect transmission lines in the remaining territory in Carroll County not now served with electricity.

MARTINSVILLE, VA. — The Southern Virginia Power Corporation has awarded a contract to the Ambursen Construction Company, Grand Central Terminal, New York City, for the development of a hydro-electric plant on the Smith River, near Martinsville, consisting of a dam about 50 ft. high and 700 ft. long and a power house equipped with three 1,200-hp. units. The company will supply energy to the town of Martinsville and to various industries in this section.

WASHINGTON, D. C.—Bids will be received by the Commissioners of the District of Columbia, District Building, until March 9 for electrical supplies for the fiscal year, including electric lamps, sockets, switches, wire, fans, ammeters, batteries, conduits, flashlights, fuses, etc. (Class 17).

North Central States

BATTLE CREEK, MICH.—Bids, it is reported, will be asked early in March by Thomas Thorne, city clerk, for the installation of a central fire-alarm station, to cost about $10,000.

DETROIT, MICH.—Bids will be received until March 10 by D. A. Bohlen & Son, Majestic Building, Indianapolis, Ind., architects, for a power plant with generators, engines, boilers, pumps, etc., to be built in connection with a college for women at Wyoming Street and Six-Mile Road, Detroit, for the Sisters' Servants of the Immaculate Heart of Mary, Monroe. The entire project will cost about $1,000,000.

GARDEN, MICH.—Norman J. Beaudry and associates have been granted a franchise to build an electric power plant for local commercial service.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, Room 226, City Hall, until Feb. 27 for lead-covered cable for the Division of Light and Power.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company contemplates extensions to its light and power system, to cost about $250,000 and for additional freight terminal facilities, to cost about $150,000.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, Room 226, City Hall, until Feb. 27 for 300 cells of storage battery, 5,000 ft. sixteen-conductor lead cable and 7,500 ft. of ten-conductor lead cable for the Department of Public Safety. Separate bids to be submitted on each item.

HAMILTON, OHIO.—The Union Gas & Electric Company plans to erect a service and operating building on South Second Street, near Court Street, to cost about $70,000.

LIMA, OHIO.—The Lima Telephone & Telegraph Company contemplates extensions to its system, to cost about $240,000.

POWHATTAN, OHIO.—The Consolidated Fuel Company, Chamber of Commerce Building, Pittsburgh, Pa., plans to install electric power equipment in connection with a new steel tipple at its local properties and general mining machinery. The entire cost is estimated at $250,000.

TORONTO, OHIO.—Plans for rebuilding the plant of the Toronto Fire Clay Company, destroyed by fire some time ago, include a power plant.

LOUISVILLE, KY.—The Southern Brick & Tile Company contemplates rebuilding its power house, recently damaged by fire with loss of about $25,000.

DANVILLE, ILL.—The construction of a high-tension steel-tower transmission line across central Illinois this year connecting Urbana, Champaign, Bloomington, Peoria, Decatur, Springfield and Danville is under consideration by the Illinois Power & Light Corporation, Chicago. Extensions will be made to the power plant in Danville, including the installation of turbines of 21,000 hp., increasing the output of the plant to 47,000 hp. The cost of improvements to the local plant is estimated at $1,000,000.

GREAT LAKES, ILL.—Bids will be received by the United States Veterans' Bureau, Room 791, Arlington Building, Washington, D. C., until March 17 for construction complete of diagnostic buildings, continued treatment buildings, mess and kitchen building, acute patients' building, etc., at the United States Veterans' Hospital, Great Lakes. Separate proposals will be received for building construction, plumbing, heating, electrical work, elevators and ice-making and refrigerating plant. Frank T. Hines is director.

GREEN BAY, WIS.—Steps have been taken by the West Side Civic Association to secure the installation of an ornamental lighting system on the West Side.

GREEN BAY, WIS.—The Wisconsin Public Service Corporation is considering extending its transmission line from Algoma to Rio Creek, a distance of 10 miles.

MADISON, WIS.—The Wisconsin Power, Light & Heat Company is considering the erection of a transmission line in Green Lake County, to cost about $25,000.

MARINETTE, WIS.—The City Council is considering submitting to the voters the proposal to install an ornamental lighting system on Main Street in the business district and on Hall Street.

RIPON, WIS.—Arrangements are being made by the Wisconsin Power & Light Company, Madison, to extend its transmission lines to furnish electrical service in Waukau and Eureka. It also proposes to erect another line along the south shore of Green Lake to supply electricity to the summer resorts and farmers in that district.

SUPERIOR, WIS.—Extensions and improvements are contemplated by the Superior Water, Light & Power Company during 1925, to cost about $23,000.

WAUSAU, WIS.—Plans are being considered by the Wisconsin Valley Electric Company to extend its transmission line from Tomahawk to Rhineland, a distance of about 25 miles, where it has recently acquired the electric properties.

HARLAN, IOWA.—Improvements to the municipal electric light and power plant are under consideration by the City Council.

INDEPENDENCE, MO.—Plans are under way for extensions and improvements in the municipal electric plant, to include the installation of additional equipment. Black & Veatch, Mutual Building, Kansas City, are engineers.

LINCOLN, NEB.—The State Board of Control has applied to the State Legislature for an appropriation of $100,000 for the construction of a new light and power station at the penitentiary, which supplies electricity to the State institutions and public buildings in Lincoln. A survey is planned to ascertain whether or not the University of Nebraska, the State Agricultural College and the state fair grounds may not also be furnished light and heat by the same plant.

LYONS, NEB.—The Town Council is planning to erect a transmission line to Rosalie from the municipal electric plant to furnish light and power service there.

NORFOLK, NEB.—Extensions in the electric lighting system are under consideration by the City Council.

Southern States

ELON COLLEGE, N. C.—The board of trustees of Elon College is planning to rebuild the power house at the institution, recently damaged by fire.

KINSTON, N. C.—The installation of an ornamental lighting system is under consideration by the City Council.

LAURINBURG, N. C.—The Norman Power & Milling Company plans to build a power plant. It will be operated under lease by D. A. Monroe.

RALEIGH, N. C.—The Carolina Power & Light Company has acquired the properties of the North State Power Company, which operates in the towns of Angier, Four Oaks, Fuquay Springs, Holly Springs, Kenly, Lillington, Micro, Pine Level, Princeton and Varina. In taking over the properties the Carolina company has agreed to complete the proposed extension of the North State company to Coats and Buies Creek.

BELTON, S. C.—The Belton Light & Power Company, recently organized, will take over the plant and holdings of the Belton Power Company. Louis Steel, Jr., is president of the new company.

CHESTERFIELD, S. C.—R. E. Evans, R.F.D. No. 3, Chesterfield, is planning to purchase a 25-hp. turbine waterwheel and accessory equipment for a local plant.

AUGUSTA, GA.—Arrangements have been made by the Augusta-Aiken Railway & Electric Corporation and the Georgia Railway & Power Company for the construction of a high-tension transmission line from Toccoa to Augusta, to cost about $1,500,000. The proposed line will be about 100 miles long and will supply electricity from the Tugalo power station of the Georgia Railway & Power Company to Augusta and a number of other places in Georgia and South Carolina. Distribution systems will be erected in Warrentown, Campania, Harlem, Washington and Thomson in Georgia and Denmark, Barnwell, Orangeburg and other cities in South Carolina.

GRIFFIN, GA.—The Public Utilities Commission has approved the sale of the hydro-electric plant of the Towaliga Falls Power Company, near Griffin, to the Georgia Hydro-Electric Company.

DE LAND, FLA.—Extensions and improvements, to cost about $50,000, during 1925, are contemplated by the Florida Public Service Company.

ORMAND, FLA.—Bids will be received by the Board of Managers of the town of Ormond until March 10 for construction of a waterworks system, including drilled wells, pumping station, motor-driven centrifugal pumps, gasoline engine-driven centrifugal pump, stand-by unit, low-pressure, motor-driven air compressor, water-softening plant, electric generating unit of about 150 hp., piping system, hydrants, meters, etc. The Main Engineering Company, Dayton, is engineer.

BRISTOL, TENN.—Improvements are contemplated by the Bristol Gas & Electric Company to its gas and electric systems, to cost about $128,400, during the next six months.

CHATTANOOGA, TENN.—Plans are under way for the installation of an improved lighting system on several streets in the Twelfth Ward. The work will be done by the Tennessee Electric Power Company.

BAY MINETTE, ALA.—The Baldwin County Electric Light & Power Company, Fairhope, has applied to the Public Service Commission for permission to construct an electric generating plant and distributing system in Baldwin County.

GANTT, ALA.—The Public Service Commission has granted the River Falls (Ala.) Power Company permission to erect a transmission line from Gantt to Brantley via Dozier.

HAZLEHURST, MISS.—The City Council is considering extensions and improvements to the municipal electric light plant.

JANESVILLE, LA.—Bonds to the amount of $40,000 have been authorized for the installation of an electric light plant and waterworks system.

MANSURA, LA.—Bids will be received by the Mayor and the Board of Aldermen until Feb. 25 for electric light and waterworks improvements as follows: One 50-hp. and one 100-hp. crude-oil engine, directly connected to alternators and power pump, of 500 gal. capacity per minute; two exciters, motor-driven air compressor, motor-driven centrifugal pump, 8-in. tubular well, 68,000-gal. concrete reservoir, 50,000-gal. elevated tank and tower, cast-iron pipe, etc. F. P. Joseph, Glenmora, is engineer.

LAWTON, OKLA.—The Southwestern Light & Power Company is planning to extend its transmission lines in this section, to cost about $200,000.

McALESTER, OKLA.—The McAlester Cotton Oil Company plans to rebuild its power house, recently damaged by fire. The loss is estimated at $50,000.

ANTON, TEX.—The Texas Utilities Company, Plainview, plans to erect a transmission line from Lubbock to Anton for local commercial service.

CANYON, TEX.—The Texas Utilities Company, Plainview, has entered into a contract with the City Commission to furnish electricity for lighting and power purposes to the town. The construction of an electric power plant in Canyon, to cost about $150,000, is under consideration by the company.

LITTLEFIELD, TEX.—The electric plant of the Littlefield Light & Power Company has been acquired by the Texas Utilities Company, Plainview. The company contemplates erecting transmission lines from the local plant to the towns of Anton, Amherst and Sudan.

MINERAL WELLS, TEX.—The Mineral Wells Electric Company plans extensions and improvements in its system.

SAN ANTONIO, TEX.—Plans are under way by the San Antonio Public Service Company for extensions to its power plant, to cost about $210,000.

SCHUYLER, TEX.—The Council is considering the construction of a transmission line to secure electricity for local service. It is proposed to close down the municipal power station.

STRATFORD, TEX.—Bonds to the amount of $20,000 have been authorized for an electric light plant and waterworks system.

WESTBROOK, TEX.—The West Texas Utilities Company, Abilene, contemplates erecting a transmission line from Colorado to Big Springs.

Pacific and Mountain States

ABERDEEN, WASH.—The City Council is planning to install an improved lighting system in the vicinity of E. Street.

BELLINGHAM, WASH.—The Puget Sound Power & Light Company, Seattle, plans to erect a transmission line on county road No. 101, in this section.

FERNDALE, WASH.—The Whatcom County Power & Light Company plans to erect a transmission line on County Road No. 424.

LONGVIEW, WASH.—Plans are said to be under consideration by the City Council for extensions and improvements in electric light and power systems, including a fire-alarm and traffic signal system, to cost about $250,000.

MILLWOOD, WASH.—The Inland Empire Paper Company plans to install electric power equipment in its proposed addition, to cost $135,000.

POMEROY, WASH.—Surveys are under way by the Pacific Power & Light Com-

pany, Portland, Ore., for a transmission line between Lewiston and Pomeroy, which will supply energy in Pomeroy, Dayton and Walla Walla.

SPOKANE, WASH.—A building program for 1925 providing for an expenditure of $1,480,000 has been approved by the Washington Water Power Company. The work will include a new substation in Spokane, the site yet to be selected, reconstruction of distribution lines in the city, new transformers, etc.; extensive improvements in transmission line and distribution system at Okanogan and Brewster, installation of three 2,000-kva. transformers at Stratford, and extensions and improvements to the system in the mining district of the Coeur d'Alenes, etc.

FRESNO, CAL.—The Sun-Maid Syrup Company plans to build a power plant, in conjunction with a group of buildings, to cost about $100,000. Shields, Fisher & Lake, Pacific-Southwest Building, are architects.

FRESNO, CAL.—Plans are under way for the installation of ornamental lighting systems on Fifth, Sixth, Seventh, Eighth, Ninth and Tenth Streets, from Platt to Kerckhoff Streets; on Platt Street, between Fifth and Twelfth Streets, and on Willis Avenue, from Blackstone to Fresno Streets. William Stranahan is city engineer.

HERMOSA BEACH, CAL.—Plans are under way for the installation of ornamental lamps on Hermosa, Pier and Manhattan Avenues; also on a portion of Camino Real. H. R. Taylor is city engineer.

LOS ANGELES, CAL.—The Bureau of Power and Light is considering the construction of a machine shop at 1600 North Main Street for maintenance and repair of electrical equipment, to cost about $160,000.

LOS ANGELES, CAL.—The City Council has approved an ordinance for the installation of an ornamental lighting system on Pasadena Avenue from Woodside Drive to Avenue 41, using concrete standards, and also on portions of Catalina Street, Harcourt Avenue, Ambrose Avenue and on First Street.

POMONA, CAL.—The Southern California Edison Company, Los Angeles, has appropriated about $400,000 for extensions and improvements to its ssytem in this district during 1925.

SAN FRANCISCO, CAL.—Stephen E. Kieffer, Mechanics' Institute Building, and associates have applied for permission to appropriate water from the Mokelumne River, a tributary of the San Joaquin River, in Amador County, for a hydro-electric development, to cost about $500,000.

SAN GABRIEL, CAL.—Bids will be received by I. H. Stouffer, city clerk, until Feb. 24 for the installation of street lamps, using metal standards, on Alhambra and Shore Roads, to cost about $25,000.

SANTA ANA, CAL.—The Southern California Edison Company has appropriated about $600,000 for extensions and improvements in this district during 1925.

SEAL BEACH, CAL.—Plans are under consideration for the installation of an ornamental lighting system on Main Street between the Coast Highway and Ocean Avenue.

TULARE, CAL.—The Southern California Edison Company, Los Angeles, plans to expend about $350,000 for extensions and improvements to its system in this district during 1925.

VALLEJO, CAL.—The Pacific States Electric Company has submitted a proposal to the Council for the installation of an ornamental lighting system on Marin Street. E. D. Kilkenny is city engineer.

Canada

SEEBE, ALTA.—Plans are under way by the Calgary Power Company to increase the output of the substations at Calgary and Seebe, at a cost of about $50,000. The company also plans to purchase new transformers for the Seebe station, to cost about $75,000.

WINNIPEG, MAN.—Tenders addressed to the chairman of committee on public utilities will be received by C. J. Brown, city clerk, until March 2 for three 2,500-kva. transformers for No. 6 substation of the Hydro-Electric System.

PORT ARTHUR, ONT.—Application is being made by the Hydro-Electric Power Commission of Ontario, Toronto, under the navigable waters protection act for permission to construct a dam in the Nipigon River at a point north of Virgin Falls.

SANDWICH, ONT.—Tenders will be received by the town of Sandwich until Feb. 23 for $33,000 in debentures, the proceeds to be used for Hydro-Electric works.

Electrical Patents

Announced by U. S. Patent Office

(Issued January 27, 1925)

1,524,130. SWITCH; Ray S. Hardin, Chicago, Ill. App. filed Nov. 16, 1923. Remote control.

1,524,141. RACK; William D. Kyle, Milwaukee, Wis. App. filed Oct. 5, 1921. For spool insulators.

1,524,142. STRAIN INSULATOR; William D. Kyle Milwaukee, Wis. App. filed Dec. 30, 1921. For guy wires.

1,524,149. FUSE TERMINAL; Henry T. Paiste, Philadelphia, Pa. App. filed March 31, 1922.

1,524,153. METER PROTECTIVE DEVICE; Joseph Sachs, Hartford, Conn. App. filed Jan. 12, 1918.

1,524,174. SOUND-REPRODUCING MACHINE; Leon F. Douglass, San Rafael, Cal. App. filed July 15, 1919. Comprising a secondary reproduction of sound by the use of a telephonic circuit.

1,524,193. ELECTRIC TOASTER; Nelson E. Mann, Newington, Conn. App. filed June 10, 1924.

1,524,194. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed July 3, 1920.

1,524,205. ELECTRIC LAMP; Julius Papke, Moberly, Mo. App. filed Jan. 2, 1924. Used as a flashlight or for steady illumination.

1,524,211. ELECTRICALLY HEATED SADIRON; Asher Pritzker, Toronto, Ontario, Canada. App. filed May 23, 1924. With temperature indicator.

1,524,226. ELECTRICAL INSTALLATION; Ralph W. Atkinson, Perth Amboy, N. J. App. filed April 17, 1922. Of parallel electric cables.

1,524,232. DOOR INDICATOR; Otto Bergstrom, Bridgeport, Conn. App. filed Jan. 5, 1920. Signal device.

1,524,247. AUTOMATIC TRAFFIC REGULATOR; Frank J. Husbands, Los Angeles, Cal. App. filed April 20, 1920.

1,524,278. TELEPHONE INSTRUMENT; Frank H. Alder, St. Lambert, Quebec, Canada. App. filed Jan. 10, 1923.

1,524,285. METHOD OF AND MEANS FOR MEASURING ELECTRIC CURRENT; Ernst Besag, Frankfort-on-the-Main, Germany. App. filed July 30, 1914. Measuring continuous current by modifying the flux induced in an alternating-current circuit.

1,524,311. AUTOMATIC TELEPHONE SYSTEM; Fred R. Quayle, Wilmette, Ill. App. filed Oct. 15, 1920.

1,524,312. AUTOMATIC TELEPHONE SWITCH; Osvald E. Rasmussen, Lincoln Park, N. J. App. filed March 15, 1922.

1,524,344. CO-ORDINATE SWITCH; Henry F. Dobbin, New York, N. Y. App. filed May 4, 1922. Used in an automatic telephone-exchange system.

1,524,357. TELEGRAPHY; George E. Hudson, Brooklyn, N. Y. App. filed May 20, 1920. "Single" telegraph system.

1,524,370. DRIVING MOTOR FOR TALKING MACHINES, DICTATING MACHINES AND THE LIKE; Georg Seibt, Berlin-Schoneberg, and Georg Schernbeck, Berlin Tempelhof, Germany. App. filed Nov. 17, 1923.

1,524,379. TELEPHONE-EXCHANGE SYSTEM; Rand S. Bailey, Montclair, N. J. App. filed March 24, 1921. Cord-circuit arrangement for use at a private-branch exchange in connection with a central office of the automatic type.

1,524,402. ANTI-SIDE-TONE SUBSTATION CIRCUIT; Frederick W. McKown, New York, N. Y. App. filed July 17, 1919. Telephone substation circuit.

1,524,407. INSULATOR FOR SUSPENDED HIGH-TENSION ELECTRIC WIRES; Alfred Renaudin, Lyons, France. App. filed Feb. 26, 1921.

1,524,408. LIGATURE FOR CONNECTING INSULATING ELEMENTS FOR SUSPENDED HIGH-TENSION WIRES; Alfred Renaudin, Lyons, France. App. filed Feb. 26, 1921.

1,524,412. SNAP-CIRCUIT CONTROLLER; James E. Stephenson, Rochester, N. Y. App. filed March 19, 1920. Rotary type.

1,524,413. WIRELESS-TELEPHONE SYSTEM; Morton W. Sterns, New York, N. Y. App. filed Jan. 28, 1920.

1,524,417. ELECTRICALLY HEATED UTENSIL; Maurice L. Warner, Meriden, Conn. App. filed June 21, 1923. With automatic cut-off when the temperature reaches a predetermined degree.

1,524,430. DEVICE FOR HEATING BUILDINGS BY ELECTRICAL ENERGY; Otto Graber, Lucerne, Switzerland. App. filed April 11, 1923.

1,524,426. HYDRAULIC TURBINE; Ralph S. Hyatt, Valentine, Neb. App. filed Feb. 8, 1924. With means for preventing the formation and adherence of ice to the metal parts.

1,524,448. PLATING AND METHOD OF ACCOMPLISHING SAME; James A. Murphy, Lansing, Mich. App. filed April 26, 1923.

1,524,479. ELECTRICAL TOASTER; Frank L. Kohlhase, Chicago, Ill. App. filed March 19, 1923.

1,524,496. ALTERNATING-CURRENT MOTOR; Tadaoki Yamamoto, Takata-Machi, Tokyo, and Masataro Kawarada, Nippori-Cho, Tokyo, Japan. App. filed June 23, 1922. Induction motor and series commutator generator connected in cascade.

1,524,514. CONNECTING BOX; Otto H. Frank, Brooklyn, N. Y. App. filed Aug. 16, 1923. For connecting various devices to be arranged in groups.

1,524,517. APPARATUS FOR HEATING WATER IN CIRCULATING AND OTHER SYSTEMS; Douglas G. Jack, Gisborne, New Zealand. App. filed June 21, 1924.

1,524,532. AUTOMATIC TOASTER; Herman M. Biebel, Oakmont, Pa. App. filed Feb. 20, 1924. For the simultaneous toasting and delivery of slices of bread.

1,524,534. RELAY; Edgar W. Breisch, Edgewood Park, Pa. App. filed July 9, 1921. Of the balanced type; as used for the remote control of two groups of street lamps.

1,524,539. ELECTRIC FURNACE; Ora A. Colby, Irwin, Pa. App. filed Nov. 16, 1921. Resistance type.

1,524,544. FIRE ALARM AND INDICATOR; Edgar C. Fisher, Huntington, West Va. App. filed July 5, 1922.

1,524,546. ELECTRIC WAFFLE IRON; Frank F. Forshee, Mansfield, Ohio. App. filed Aug. 8, 1922.

1,524,553. CONTROL SYSTEM AND SWITCH MECHANISM THEREFOR; Henry D. James, Edgewood Park, Pa. App. filed Nov. 4, 1918. Motor-accelerating system.

1,524,557. AUTOMATIC WELDER; Otis A. Kenyon, New York, N. Y. App. filed Dec. 13, 1920. Electric arc type.

1,524,558. INSULATION FOR CONDUCTORS IN SQUIRREL-CAGE MOTORS; Charles W. Kincaid, Carrick, Pa. App. filed Oct. 28, 1922. Rotor-bar insulation.

1,524,560, 1,524,561. DRY-CELL BATTERY; Harry M. Koretzky and Boris H. Teitelbaum, New York, N. Y. App. filed March 2, 1920. Deferred-action type.

1,524,562. PROTECTIVE SYSTEM; Jan A. Kuyser, Sale, England. App. filed Jan. 26, 1922. For turbine-driven generators.

1,524,571. THERMALLY OPERATED CONTROL DEVICE; Thomas A. Reid, Pittsburgh, Pa. App. filed June 3, 1921.

1,524,579. TROLLEY-POLE HEAD; William Schaake, Pittsburgh, Pa. App. filed May 19, 1922.

1,524,580, 1,524,581. AMPLIFYING SYSTEM; John Scott-Taggart, Ilford, England. App. filed Sept. 29, 1924, For use in wireless telegraphy and telephony.

1,524,587. MEASURING SYSTEM; Harry P. Sparkes, Wilkinsburg, Pa. App. filed Nov. 29, 1921. Means for effecting indications of the several and collective loads on a plurality of main circuits at a central or local position.

1,524,591. TRANSFORMER; Alden B. Starr, Brooklyn, N. Y. App. filed Feb. 7, 1924. Radio type, shielded.

1,524,629. MODULATING SYSTEM FOR OSCILLATION GENERATORS; Alexander Nyman, Wilkinsburg, Pa. App. filed Jan. 26, 1921.

1,524,631. TROLLEY-REPLACING DEVICE; William E. Phillips, Jacksonville, Fla. App. filed Nov. 2, 1923.

1,524,642. THERMOSTAT; Emil Stranszky, Dover, Ohio. App. filed Dec. 18, 1918.

1,524,645. RECEVING APPARATUS FOR ELIMINATING STATIC; Marius Latour, Paris, France. App. filed Aug. 19, 1921.

1,524,646. CONNECTION OF HIGH-FREQUENCY ALTERNATORS FOR RADIO SIGNALING; Marius Latour, Paris, France. App. filed Dec. 5, 1923.

(Issued February 3, 1925)

1,524,650. RECONSTRUCTED FUSE PLUG; A. Hansen, New York, N. Y. App. filed Aug. 24, 1922.

1,524,665. TELEPHONE SYSTEM; E. W. Lincoln, Chicago, Ill. App. filed May 31, 1921. Measured-service system.

1,524,714. METHOD OF AND APPARATUS FOR ELECTRIC ARC WELDING; J. Kjerkstad, Brooklyn, N. Y. App. filed Nov. 2, 1918.

1,524,801. SAFETY INCLOSED SWITCH; C. F. Schwennker, Schenectady, N. Y. App. filed March 30, 1922.

1,524,815. COMBINATION SWITCH LOCK; L. L. Chessman, Syracuse, N. Y. App. filed Aug. 6, 1923.

1,524,828. ELECTRICAL CIGAR LIGHTER; W. Kasten, Brooklyn, N. Y. App. filed Sept. 1, 1923.

Financial and Corporate

Utility Market Breaks

Substantial Declines Registered by Many Leading Issues During Week

THE market in power and light stocks for a week or more has moved with uncertainty, but on Saturday and again on Monday, when the general markets were weak, utility issues fell to fresh low levels for the year. Declines were all the sharper, perhaps, for the reason that theretofore the market in power and light stocks had had no substantial corrections in technical position such as the other markets have had from time to time in recent weeks.

The stock of the Electric Bond & Share Securities Corporation, which in recent weeks had been a leader in the trading, lost approximately ten points in selling down to a new low of 56¼, a price, incidentally, that compares with about 105 at the peak earlier this year. The stocks of several companies under the supervision of the Electric Bond & Share Company lost considerable ground during the week, Lehigh Power Securities having dropped twenty points and at its low point of 82 on Monday being down nearly twenty-five points from its level the week before. American Power & Light lost nine points during the week, the stock selling below 50 for the first time in weeks, and American Gas & Electric Company's stock lost five points. Other noteworthy losses were the declines in Commonwealth Power Corporation's stock to below 110 at one time, or eight points under its level of the week before; in National Power & Light, which fell twelve points, and in Electric Investors, Inc., which fell five points.

The market in the North American Company's stock has been unusually active during the past week or so and, except for the profit taking that came in when the general market declined Monday, has been strong. The stock established a new high at 48¾, partly in anticipation of the favorable earning figures that are expected when the directors meet around February 20. Virginia Railway & Power on the Exchange, after holding for weeks around 66, ran up to 83 before dropping to 75.

New Capital Issues

During the past week electric light and power companies floated new issues of bonds and stocks to the amount of $21,940,000. The largest individual piece of financing was done by the American Gas & Electric Company in the form of 6 per cent gold debenture bonds, totaling $9,000,000. The bonds were priced at 97 and accrued interest, to yield over 6.15 per cent. The Indiana & Michigan Electric Company, just formed by the consolidation of the present Indiana & Michigan Electric Company and the Twin Branch Power Company, as noted elsewhere in this issue, offered an eight-million-dollar-issue of first and refunding mortgage gold bonds, dated March 2, 1925, and due March 1, 1955, the price being 95½ and interest. Also represented in the week's financing was the Nebraska Power Company, with an issue of first mortgage thirty-year gold bonds, totaling $2,000,000, secured by a first mortgage upon the entire physical property, rights and franchises of the company. The Lockhart (S. C.) Power Company, which does almost exclusively a wholesale business, offered investors first mortgage sinking-fund gold bonds, amounting to $1,500,000, at 96 and interest, yielding over 5.80 per cent. Upon completion of this financing there will be no other funded debt outstanding.

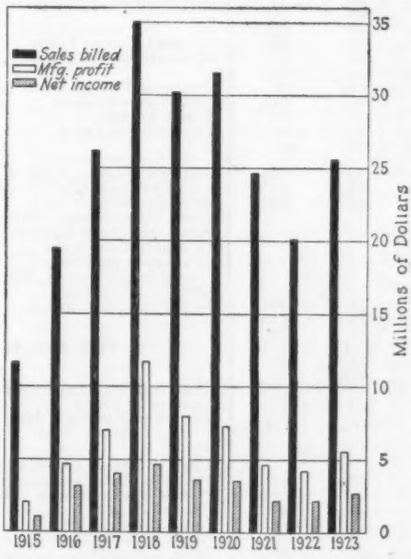
To raise funds for additions and improvements the Southern Power & Light Company offered 15,000 shares of cumulative participating preferred stock at $96 per share. The company, organized under the laws of the State of Maryland to acquire the business and property of the Southern Power & Light Company (Delaware), will own or control through stock ownership the Arkansas Light & Power Company, the Mississippi Power & Light Company, the Louisiana Power Company and the Louisiana Power & Light Company, and indirectly, through the Arkansas Light & Power Company, the Pine Bluff Company. The service of the controlled companies extends throughout a large territory in Arkansas, Louisiana and Mississippi estimated to have a population in excess of 1,000,000.

Allis-Chalmers Earnings Grow

This Manufacturer of Electrical Equipment, Which Benefits from the Industry's Growth, Is Fortunate in Being Free from Funded Debt

BY PAUL WILLARD GARRETT

INCORPORATED on March 15, 1913, the Allis-Chalmers Manufacturing Company is the successor to the old Allis-Chalmers Company that went into receivership the year before. The extraordinary rise in the price of Allis-Chalmers Manufacturing Company common shares on the New York Stock Exchange from 41 and a fraction less than a year ago to a recent high for all time of 82¾ has attracted considerable attention.



SALES OF ALLIS-CHALMERS MANUFACTURING COMPANY SHOW SUBSTANTIAL INCREASE

Partial explanation for the increasing attractiveness to investors of Allis-Chalmers shares lies, of course, in the great confidence that people have in the power and light industry and their knowledge that this company manufactures electrical equipment for the use of power companies. In former times the company primarily was interested in the manufacture of such things as agricultural machinery, and it still has a diversified plan of manufacture, but with the great growth in the demand for power and light machinery the company has been directing its attention more and more to the making of electrical equipment. It is to that phase of the business that investors look in figuring that the company's securities steadily are working into a better and permanent investment position.

Sales billed in 1914 aggregated only $10,323,150, from which level the total rose to $20,794,046 for 1922 and, according to preliminary figures, to $27,855,524 for 1924. Sales, of course, ran into substantially higher figures during the period that the war was on, the peak having been reached in 1918, when the sales totaled $35,031,234.

NOTHING AHEAD OF THE STOCKS

Stock purchasers have been impressed with the financial set-up of the Allis-Chalmers Company for the reason that no bonds stand ahead of the stock issues. Holders of the 7 per cent cumulative preferred and of the common stock are in position to benefit directly from earning gains. The preferred stock has several features not found in other issues of that description, the outstanding provisions being those that no mortgage lien can be placed ahead of the preferred stock without consent of 80 per cent of the preferred stock and that the preferred stockholders have the right to elect a majority of

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stocks is $100.)

Companies	Bid Price Saturday, Feb. 14	Low 1925	High 1925
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	99	98	101
Appalachian Power, 7 per cent	96½	92	100
Arkansas Light & Power 7 per cent	94	92	98
Asheville Power & Light 7 per cent	a 99	99	100
Central Illinois Public Service 6 per cent	84½	84	87
Colorado Power 7 per cent	93	93	98
Connecticut Light & Power 7 per cent	105	105	110
Consumers' Power 6 per cent	90	90	93
Dayton Power & Light 6 per cent	94	88	100
Duquesne Light 7 per cent	106	105	107½
Eastern Texas Electric 6 per cent	100	100	105
Empire District Electric 6 per cent	78	78	85
Fort Worth Power & Light 7 per cent	a100	100	102
Great Western Power 7 per cent	98	...	...
Illinois Northern Utilities 6 per cent	84	82	87
Illinois Power & Light 7 per cent	94	92½	98
Kansas Gas & Electric 7 per cent	a 98	98	100
Long Island Lighting 7 per cent	101	100	105
Minnesota Power & Light 7 per cent	a 96	96	98
Mississippi River Power 6 per cent	87½	87½	90
Nebraska Power 7 per cent	a 98	98	100
Niagara Falls Power 7 per cent—25	a 28	28	29
Niagara, Lockport & Ont. Power 7 per cent	106	101½	110
Northern States Power 7 per cent	96½	95	99
Ohio Public Service 7 per cent	97½	97	100
Pacific Gas & Electric 6 per cent	95	92	97
Pacific Power & Light 7 per cent	a 98	98	100
Penn-Ohio Power & Light 7 per cent	91½	91	97
Pennsylvania Power & Light $7—no par	a101	100	101½
Penn. Public Service 7 per cent	90	90	100
‡Philadelphia Electric 8 per cent—25	42½	40	44½
Southern California Edison 8 per cent	116	115	120
Tennessee Electric Power, 6 per cent	81½	80	84
Texas Power & Light 7 per cent	a100	100	101
Utah Power & Light 7 per cent	a 97	97	99
Western States Gas & Electric 7 per cent	82	82	85
Yadkin River Power, 7 per cent	a 98	98	100
Holding Companies			
American Gas & Electric 6 per cent—50	45½	45	47½
American Light & Traction	93½	93	95½
American Power & Light 6 per cent	87½	86	90
American Public Service 7 per cent	87	88	92
American Public Utilities 7 per cent	87	87	95
American Water Works & Electric 7 per cent	a101	95½	102½
Associated Gas & Electric 7 per cent—1 per cent extra—50	a 50	...	...
Carolina Power & Light 7 per cent	100	100	105
Central Indiana Power 7 per cent	88	88	93
Cities Service 6 per cent	80	80	81½
Commonwealth Power 6 per cent	80	80	82½
Consolidated Gas 6 per cent—50	57½	57½	58½
Continental Gas & Electric 7 per cent pr. pf.	91	89	95
Electric Bond & Share 6 per cent	102	102	103½
General Gas & Electric—$8—no par	105	104½	110
*Middle West Utilities 7 per cent	94½	91½	94½
National Power & Light—$7—no par	96	95	98
North American 6 per cent—50	a 47½	46½	48
Public Service Corp. of N. J. 7 per cent	a101½	99	102
Public Service Corp. of N. J. 8 per cent	111	...	...
§Standard Gas & Electric 8 per cent—50	a 53	53	53½
†United Gas Improvement—50	57½	57	58
United Light & Power—$6.50—no par	86	83	88
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	33	33	38
Appalachian Power—no par	74	70	83
Arkansas Light & Power	65	65	70
Brooklyn Edison	a126½	120½	133
Buffalo General Electric	197	197	199
*Commonwealth Edison	138	134½	139
§Consolidated Gas, Electric Light & Power	33½	32	34
Dayton Power & Light	200	180	215
Detroit Edison	a115	110	115½
|| Edison Electric Illuminating of Boston	a200½	...	...
Kentucky Hydro-Electric	a 92½	...	...
Long Island Lighting	250	...	...
Mississippi River Power	37	37	40
Montana Power	a67½	67½	72
Niagara Falls Power—no par	46	43	48
Niagara, Lockport & Ontario Power—no par	70	63	73
Northern Ohio Power—no par	6	5	7½
Northern States Power	104½	103	107
North Texas Electric	64	64	67
Pacific Gas & Electric	a107	102½	108½
§Pennsylvania Water & Power	132	126½	133½
‡Philadelphia Electric—25	42½	40½	45½
Public Service Co. of Northern Illinois	97	97	100
Puget Sound Power & Light	53	53	58
Southern California Edison	103	102	106
Tennessee Electric Power—no par	53	49	61
Virginia Power	70	70	92
Virginia Railway & Power	74½	64½	83
West Penn. Co.	a114	110	120
Holding Companies			
American Gas & Electric—no par	73	72	80
American Light & Traction	148	139	148
American Power & Light	54	54	67
American Public Utilities	75	75	85
American Water Works & Electric	a 38	34½	39½
Carolina Power & Light—no par	290	290	335
Cities Service	190	172	192
Columbia Gas & Electric—no par	a 46⅜	45⅜	49⅞
Commonwealth Power Corp.—no par	114	116	126
Consolidated Gas—no par	a 75½	74⅜	78⅞
Continental Gas & Electric	82	80	87
Federal Light and Traction	a133	114½	140
General Gas & Electric	73	75	81
Lehigh Power Securities—no par	95	105	116
*Middle West Utilities—no par	86½	84½	90
National Power & Light—no par	199	185	230
North American—10	a 46⅞	41⅜	48⅞
Philadelphia Co.—50	a 53⅜	52½	57½
Power Securities—no par	19	...	...
Public Service Corp. of N. J.—no par	70½	67½	72
Standard Gas & Electric—no par	a 41½	40½	46
United Gas & Electric (Conn.)—no par	31	31	37½
Utah Securities	45	42	53
BONDS			
Operating Companies			
Adirondack Power & Light 6s 1950	103½	102½	103½
Alabama Power 5s 1946	97	96	97
Appalachian Power 5s 1941	97	96	97
Brooklyn Edison 5s 1949	99⅞	99½	100
6s 1930	105	104½	105
Cleveland Electric Illuminating 5s 1939	100½	100	101½
Commonwealth Edison 5s 1943	100	99½	100½
5s 1953	98½	98½	99½
§Consol. Gas, Elec. Lt. & Pwr. 4½s 1935	95½	95½	96½
6s 1949	105½	104½	105½
Consumers' Power 5s 1936	99	99	99½
5s 1952	95	90½	95
Detroit Edison 5s 1933	101½	100	102½
Duquesne Light 6s 1949	105½	105	106½
Great Western Power 5s 1946	96½	95	97½
Kansas City Power & Light 5s 1952	96½	95½	97½
Mississippi River Power 5s 1951	97½	96½	97½
Montana Power 5s 1943	99½	97½	99½
New England Power 5s 1951	100½	100½	101½
New York Edison 6½s 1941	114½	112½	115
Niagara Falls Power 6s 1950	105	105	106½
Northern States Power 5s 1941	95½	...	...
6s 1941	104	103	105½
Ohio Power 7s 1951	106½	106½	107½
Pacific Gas & Electric 5s 1942	95⅛	93½	95⅛
Pennsylvania Water & Power 5s 1940	100	99½	100½
‡Philadelphia Electric 5s 1966	101⅜	100½	102
5½s 1947	104½	103½	104⅞
6s 1941	106½	106	106½
Portland Electric Power 6s 1947	98	94	99½
Southern California Edison 5s 1939	99½	99½	100
6s 1944	102½	102½	103½
Tennessee Electric Power 6s 1947	100⅜	99½	101
Texas Power & Light 5s 1937	97½	97	98
Toledo Edison 7s 1941	109½	108½	109½
Utah Power & Light 5s 1944	94	...	...
Holding Companies			
Alabama Traction, Light & Power 5s 1962	86	86	87½
American Gas & Electric 6s 2014	96½	96½	97
American Power & Light 6s 2016	95	94	95
Amer. Water Works & Electric 5s 1934	95½	92½	95⅜
Associated Gas & Electric 6½s 1954	a 98½	...	...
Central Indiana Power 6s 1947	98	95½	98
Commonwealth Power 6s 1947	100	97⅜	100
Consolidated Cities Lt., Pwr. & Tr. 5s 1962	76	75½	76½
Illinois Power & Light 6s 1953	100½	100½	101½
United Light & Railways 5s 1932	95	93½	95
6s 1952	97½	95⅜	97½
ELECTRICAL MANUFACTURING COMPANIES			
PREFERRED STOCKS			
Allis-Chalmers Manufacturing	a105	103½	107
*National Carbon	121	120	124
Worthington Pump & Machinery A	a 86½	85	88
COMMON STOCKS			
Allis-Chalmers Manufacturing	a 74½	71½	82½
American Bosch Magneto—no par	a 39	33	54½
Electric Storage Battery—no par	c 63½	62⅜	70½
General Electric	a232½	227½	320
General Electric—10	a 11½	11	11½
*Hurley Machine—no par	50½	50	56
†Wagner Electric	45	26½	50
Westinghouse Electric & Manufacturing—50	a 70½	69⅜	84
Worthington Pump & Machinery	a 68½	62½	79½
BONDS			
Canadian General Electric 6s 1942	107½	107½	107⅞
General Electric 3½s 1942	84	83	84
5s 1952	102½	101½	105½
Robbins & Myers 7s 1952	70½	67	73½
Wagner Electric Mfg 7s	100½	...	...
Western Electric 5s 1944	99	98½	99½
Westinghouse Electric & Mfg 7s 1931	107⅞	107⅜	108½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. || Boston Stock Exchange § Baltimore Stock Exchange.
a Bid price Tuesday, February 17.

the board of directors. Dividends always have been earned by good margins, and the stock, which is redeemable as a whole only at 110, now sells around 106 or 107.

Four per cent is now being paid on the common stock, but President Otto H. Falk recently estimated that the company would earn approximately 8 per cent during 1924, a figure that would compare with 6 per cent in 1923 and 4 per cent in 1922. Inasmuch as the company's business still is increasing, and since to persons in touch with affairs 1925 promises to be an even better year than 1924, some reports indicate the possibility of an increase this year in the common dividend rate.

In every year since 1914 the Allis-Chalmers company has put something aside as surplus. At the close of the year that the United States entered the war, 1917, the company's surplus aggregated $5,463,604, but to that more has been added each year until by the end of 1923 the surplus reached a new high of $12,507,526. Undoubtedly the total at the close of 1924 will be even larger.

There are several ways to figure net assets applicable to the common stock, but, taking the total of such assets as $39,842,912, the net assets per share were $153.24 at the close of 1923.

Dividends Declared

During the past week the following electric light and power companies and electric manufacturing companies declared dividends:

Name of Company	Per Cent	When Payable
American Power & Light	.25	Mar. 2
American Superpower, pf.	1¾	Feb. 15
Central Indiana Power, pf.	1¾	Mar. 1
Middle West Utilities, prior lien	$1.75	Mar. 16
Nebraska Power, pf.	1¾	Mar. 2
New England Co.	1½	Feb. 14
No. Ohio Traction & Light, 6% pf.	1½	Apr. 1
No. Ohio Traction & Light, 7% pf.	1¾	Apr. 1
Northern States Power, pf.	1¾	Mar. 2
Oklahoma Gas & Electric, pf.	1¾	Mar. 14
Philadelphia Electric, com.	2	Mar. 16
Philadelphia Electric, pf.	2	Mar. 16
Rochester Gas & Electric, 5% pf.	1¼	Mar. 2
Rochester Gas & Electric, 6% pf.	1½	Mar. 2
Rochester Gas & Electric, 7% pf.	1¾	Mar. 2
Southern Colorado Power, pf.	1¾	Mar. 16
Southwestern Power & Light, pf.	1¾	Mar. 2
Standard Gas & Electric, 8% pf.	2	Mar. 16
Tampa Electric	2½	Feb. 16
Vesta Battery, pf.	1¾	Mar. 1
Westinghouse Elec. & Mfg., com.	$1	Apr. 30
Westinghouse Elec. & Mfg., pf.	$1	Apr. 15

Standard Gas & Electric Shows Record Net

The Standard Gas & Electric Company's net operating revenue for 1924 amounted to $5,981,260, according to preliminary figures, the largest ever reported by this company. It shows a gain of $877,835, or 17.20 per cent over 1923. After all charges and preferred dividends, the balance of $2,002,672 available for common stock dividends is equivalent to $6.61 a share earned on the 302,693 shares of no par value outstanding December 31, as compared with $1,643,118, or $7.75 a share, on 212,000 shares at the close of 1923. The decrease of $1.14 is due chiefly to debenture bond conversions, which caused an increase of 90,693 shares in the amount of common stock outstanding. Another important feature of 1924 operations is that Standard Gas & Electric retired through conversion more than $5,200,000 6½ per cent debentures. This means an annual saving of more than $338,000 in interest charges, equivalent to more than $1 a share on the total common stock outstanding December 31.

A large volume of new generating capacity was put into service by various operated public utility companies of Standard Gas & Electric. This additional capacity totaled 177,925 hp., about equally divided between steam and hydro-electric stations. The operated companies, at the end of October, 1924, served a combined total of 742,534 customers, of whom 514,157 are electric customers. The number of communities served was 945, with an estimated population of nearly 3,000,000. The companies had an aggregate installed hydro-electric and steam-electric generating capacity of 829,355 hp. last October, a total of 14,725 miles of high-tension transmission and distribution lines and a connected load of 1,229,518 kw., of which 642,808 kw. was lighting load and 586,709 kw. power load. For the twelve months ended October 31, 1924, the combined electric output was 1,506,072,882 kw.-hr.

Improving Utilities' Financial Structure

Survey of Future Capital Requirements and Study of Expansion Problems by Bankers and Managements Contribute to Financial Improvement

By Ralph S. Child
With Bonbright & Company, Ltd., Investment Bankers, New York

IN WORKING toward an improvement of the financial picture of the entire public utility industry so that there may be a better understanding of its problems and of its inherent soundness on the part of all concerned, certain specific points should be stressed wherein the managements of public utilities may co-operate with their bankers to the very decided advantage of them both. These are as follows:

1. Frankness as to possible difficulties which may arise with state public utility commissions or local governing bodies. Being thus informed, the banker has the opportunity to study the situation and, as is oftentimes the case when a survey is made by an outsider, a different slant is had upon the situation, with the result that constructive suggestions may often be made. This is particularly important where there are obligations of early maturity, for where there is a closer understanding of the situation by the banker and the management steps can be taken for such extension or refunding as will best enable the utility to go on with its development.

2. Careful study should be made of future capital requirements over a period of five to ten years. These can be based on past experience over a period of years, together with a consideration of such unusual circumstances as may affect growth in the years to come. This has been done by too few companies in the past and has led to a high cost in providing money and in some cases to serious delay in adding to facilities, occasioning a lack of service which in turn had a bad effect upon public relations. No doubt one reason for this is that, with the rapid and in many cases unexpected growth especially of the electric division of the industry during recent years, managements have been so occupied with their operating problems that they have been inclined to concern themselves only with the provision of new money as it was required from year to year. It is readily to be seen that this is not a constructive plan to follow. It handicaps a utility company in many ways. If the management is frank with the banker on this phase of the business, the banker can co-operate with the management in making studies, giving the company the benefit of his knowledge of other companies' situations where there have been like problems to solve, with the result that a practical, workable plan should be developed for future financing.

3. It appears at times that in some sections of the country big power plants are projected or transmission lines extended into new territory without due consideration of the economics of the situation. During the past two or three years especially, with the comparative ease of money, it has been possible to finance practically any such developments. However, with the benefits that may frequently result from interconnection and exchange of energy with neighboring companies, it should first be definitely determined whether such interconnection might not be more advantageous than the making of contemplated extensions. It has been observed in some situations that pride in building up one's own property, together with the readiness with which capital could be obtained, has led to developments where interconnection with neighboring interests, thus postponing investment perhaps for a period of years, would, from a sound economic standpoint, have been far better business. Mention is made of this tendency principally because of the fact that more and more in the eyes of governing bodies all of this growth and development of the utility industry is coming to be considered from the standpoint of business economics and the public interest. Especially is this so in the power and light division of the industry, for it is becoming more generally understood that the real benefits of interconnection of neighboring systems are the assurance of power supply, the elimination of excess reserve generating capacity and the consequent stabilization of costs to the ultimate consumer. This naturally means a stronger and better structure upon which to finance and is a phase of the business upon which the utility and the banker

should co-operate in a broad-gaged manner. A thorough and impartial survey should be made of any big construction plan under contemplation to determine its economic necessity and feasibility when viewed from the standpoint of the individual power and light company and its relation to its neighbors.

It is needless to say that no investment banker who has the interests of his clients at heart will consider financing extensions into competitive territory. He recognizes that the extension of service into a section already adequately supplied or into territory naturally the field of an established company is not sound business from an economic standpoint and ultimately can result only to the disadvantage of all.

Sale of Maine Properties Is Consummated

More than 29,000 shares of stock of the Cumberland County Power & Light Company, Portland, Me., were deposited in acceptance of the purchase offer of the Albert Emanuel Company, New York, which, as noted elsewhere, has taken over the Maine property. The purchase price is $136.50 a share. Of the total of 30,000 shares, 16,000 were owned by E. W. Clark & Company, Philadelphia, and J. & W. Seligman & Company, New York, and following an agreement for the sale of these shares a similar offer was made to minority holders. The purchasers had reserved the right not to consummate the sale unless they secured 25,000 shares.

Company Reports

Among the company reports issued during the past week for the month of December are the following:

Name of Company	Gross Revenues for December 1924	1923
Asheville Power & Light	$97,736	$83,893
Carolina Power & Light	285,400	223,427
Idaho Power	231,661	206,698
Manila Electric *	331,650	317,968
New England Co	911,875	707,218
Utah Power & Light	878,994	815,124
Yadkin River Power	186,241	170,938

* January

Montreal Light, Heat & Power Breaks All Records.—According to the annual report of the Montreal Light, Heat & Power Consolidated for 1924, all records for both gross and net earnings were again shattered. Net income applicable to dividends was equivalent to 9.99 per cent, as compared with 9.59 per cent in 1923 and 8.15 per cent in 1922. Gross earnings, at $17,394,091, show an increase of about $1,500,000.

Electricity and the Tax Collector.—Of the 759 electric light and power companies making income tax returns in 1922, 371 paid cash dividends during the year aggregating $43,544,143. With 163 concerns which reported net book profits but did not pay cash dividends, they had surplus and undivided profits at the end of the year of $98,444,339. The net taxable income reported by the 759 companies was $78,385,822. The net taxable income of 206 concerns engaged in the manufacture of general electric machinery, stationary and marine engines and refrigerating machinery in 1922 was $22,467,162. Of these companies seventy-eight paid cash dividends of $3,526,537, and, with 109 concerns which had book profits but did not pay cash dividends, had surplus and undivided profits of $90,401,394.

Commonwealth Edison Seeks Authorization. — The Commonwealth Edison Company, pursuant to recent action by its board of directors, applied to the Illinois Commerce Commission for permission to issue additional stock in the amount of $10,837,200, which will be a 12½ per cent increase. This action is taken to provide funds for the company's extensions to its property during the year. The stock will be offered to stockholders of record on April 1, and each stockholder will be entitled to subscribe for 12½ per cent of his holdings. Plan of payment will be the same as in previous years. On February 24 the stockholders will vote on increasing the authorized capital stock from $100,000,000 to $125,000,000.

New York Edison to Increase Capital Stock.—A certificate has been filed in the office of the Secretary of State by the New York Edison Company, New York City, increasing its number of shares of non-par-value capital stock from 2,022,906 to 2,508,080.

New York Utility Increases Capitalization. — The Westchester Lighting Company, Port Chester, N. Y., has filed a certificate in the office of the Secretary of State at Albany increasing its number of shares and reclassifying its stock issue from a capital of $12,500,000, consisting of 25,000 shares preferred stock ($100 par value) and 100,000 shares common stock ($100 par value), to 384,000 shares, of which 100,000 shares are common and 25,000 shares second preferred stock, both of $100 par value.

Bonds Called in February.—Among the issues called for payment during February in advance of maturity are the following: Citizens' Gas & Electric 6's, due in 1931, amounting to $2,965,500; Commonwealth Utilities 6's, due in 1933, amounting to $700,000; Minnesota Gas & Electric 6's, due in 1933, amounting to $520,500; General Gas & Electric income 7's, due in 1934, amounting to $286,300; Southwestern Utilities 5's, due in 1930, amounting to $123,000, and Lehigh Power Securities 6's, due in 1927, amounting to $2,193,300. All these issues except the last named were called in entirety.

Hartford Electric Closes Campaign. —The special campaign being conducted by the Hartford (Conn.) Electric Light Company in offering its customers a stock interest in the company through the purchase of three-year 7 per cent convertible bonds terminated last week. The financing was done to retire $3,000,000 7 per cent bonds which have been called for payment March 1. The purchaser of the new 7 per cent convertible bonds may, at his option, exchange the same on February 1, 1928, for one share of the company's stock for each $100 bond owned at that time.

Eleven Thousand Hold Stock in Tennessee Utilities.—More than 11,000 persons hold stock in the various public utility enterprises in Tennessee, according to figures made public by the Tennessee Public Service Information Bureau. The bureau's statement placed the amount of customer-ownership stock held by investors in the South at more than $50,000,000. The data collected show that the Tennessee Electric Power Company ranks first, with 4,500 stockholders of the company's preferred stock, owning 11,000 shares, and the American Telephone & Telegraph second, with 20,000 shares held by 3,600 stockholders.

Ohio Power Resumes Preferred Stock Sale.—Another opportunity for investing in preferred stock of the Ohio Power Company is to be offered customers. Last spring the company discontinued the sale of its preferred stock, but recently it has decided to resume this form of financing. The price for the present will be $91 and accrued dividend for each $100 share. "Although the company has several thousand local stockholders," the company's announcement reads, "it desires to increase this number, believing that a local enterprise should be locally owned. It believes that the people who reap the advantages of ownership of such a company should be the ones who use its services. Consequently it is encouraging everybody it serves to become a part owner of its state-wide development."

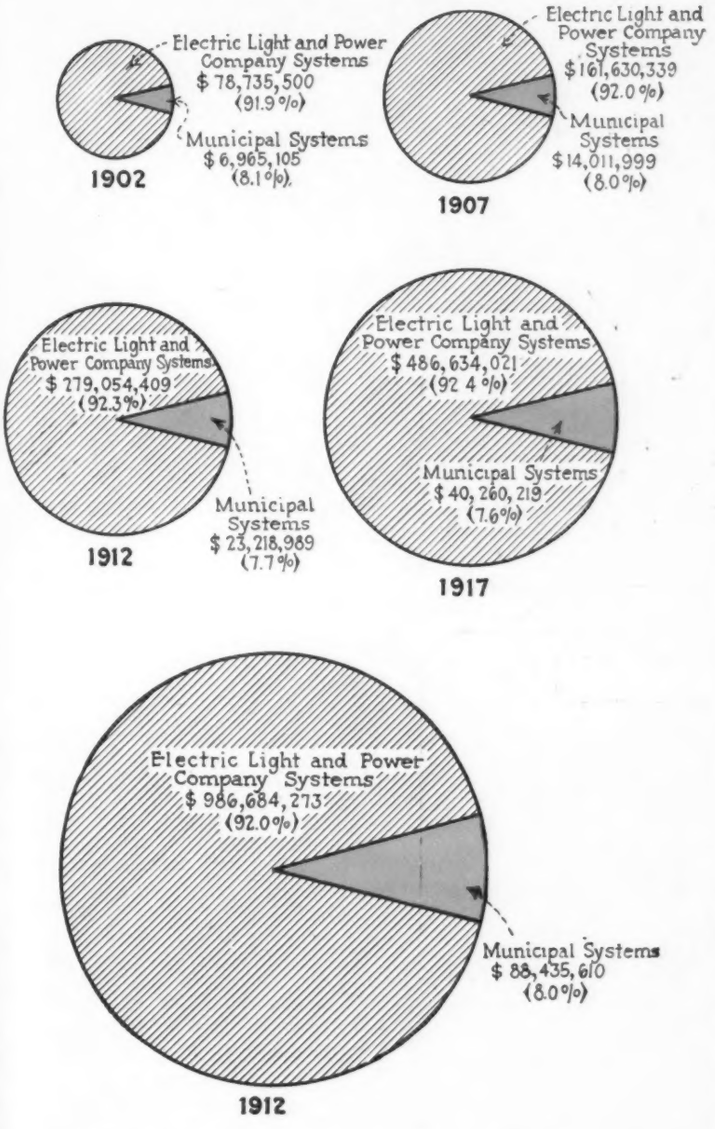
Western Power Increases Capital.—Stockholders of the Western Power Corporation have authorized an increase in the company's common capital stock from 146,700 to 300,000 shares, no par value, and in the preferred stock from 70,800 to 150,000 shares, par value $100. This increase in capital will enable the corporation to complete its purchase of the control of the San Joaquin Light & Power Corporation and its subsidiaries, to be partly financed by the issuance of 6½ per cent debentures to the amount of $6,000,000 and 72,500 shares of newly authorized common. Of the newly authorized preferred, 25,125 shares will be used in exchange for preferred stocks of the subsidiaries.

Stockholders Authorized Increase in Capitalization.—At a meeting of stockholders of the San Antonio (Tex.) Public Service Company, a subsidiary of the American Light & Traction Company of New York, an increase of capital stock of the corporation from $7,000,000 to $10,000,000 was authorized. Extensive improvements are contemplated during the present year. The report of President W. B. Tuttle showed that the company's net income for the past year was $641,939. The gross operating revenue was $4,620,034, with operating expenses, maintenance, taxes and retirement expenses totaling $3,515,531. Capital assets show plant and investment $14,980,053, with other assets bringing the total to $16,180,536. During the past year the company's bonded indebtedness was increased $1,750,000, and $500,800 in preferred stock was issued during the year.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

Revenue of the Municipal and Electric Light and Power Company Systems Show Same Rate of Growth



Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote for use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of these statistics in any way would give credit for their preparation to the ELECTRICAL WORLD.

Source of Revenue of Municipal and Private Systems Quite Different

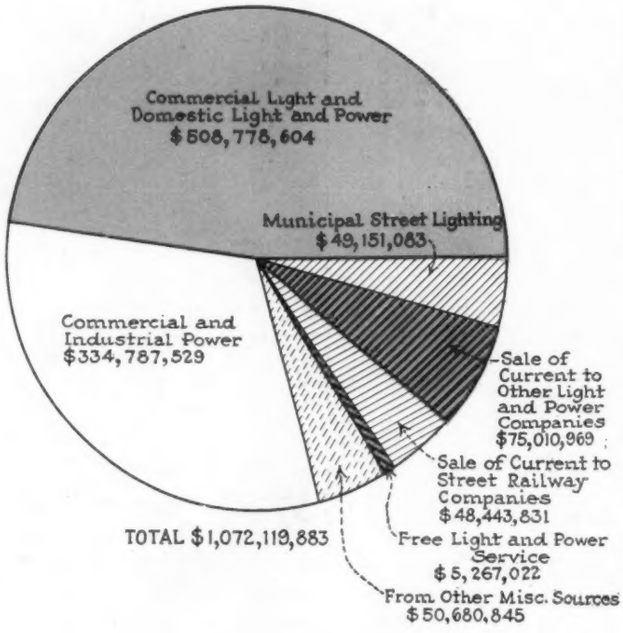
IN THE LAST analysis it is money which does the real talking. Judgment may be passed on the activities of an industry from the viewpoint of production, but it is the financial returns which in the end make for or against success. The electric light and power industry is closely regulated as to the financial returns possible. Other primary industries may charge all which the "traffic" will bear, but the public utilities of the country are held to a maximum of return.

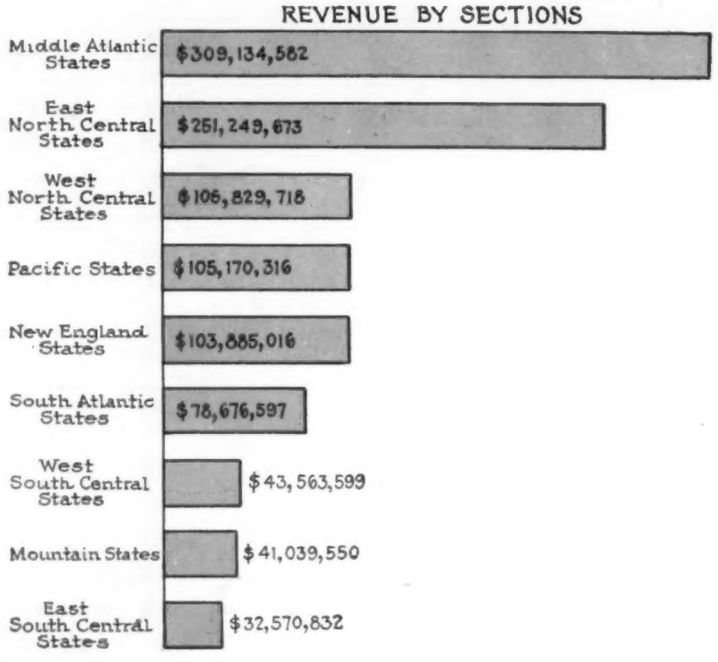
The accompanying diagrams show the growth in the gross revenue of the electric light and power company systems and the municipal systems of the country for the various census years from 1902. Financially the two types of operating systems have grown at approximately the same rate, and the relation between the two has therefore remained virtually constant.

The sources of the income for the two types of systems is quite different, however. Municipal systems are operated primarily for lighting purposes. In the case of the larger systems this statement does not hold, but it is true in the large majority of cases. Approximately 67 per cent of the gross revenue of the municipal systems comes from the high-revenue lighting customer, while approximately only 48 per cent of the revenue of the electric light and power company's system comes from this class of customers. The municipal systems are low in revenue from industrial power customers, 16.6 per cent, and high, 9.9 per cent, in their returns from street lighting, while the electric light and power company systems are high in the returns from power customers, 34.3 per cent, and low in street-lighting revenue, 4.4 per cent. The two types of systems are, therefore, almost directly opposite in the source of their revenue.

One-Half of the Central-Station Revenue Comes from Lighting Customers

—U. S. Census of Central Stations for 1922


Commercial Light and Domestic Light and Power $508,778,604
Municipal Street Lighting $49,151,083
Commercial and Industrial Power $334,787,529
Sale of Current to Other Light and Power Companies $75,010,969
Sale of Current to Street Railway Companies $48,443,831
TOTAL $1,072,119,883
Free Light and Power Service $5,267,022
From Other Misc. Sources $50,680,845


REVENUE BY SECTIONS
Middle Atlantic States $309,134,582
East North Central States $251,249,673
West North Central States $106,829,718
Pacific States $105,170,316
New England States $103,885,016
South Atlantic States $78,676,597
West South Central States $43,563,599
Mountain States $41,039,550
East South Central States $32,570,832

Sources of Revenue of Electric Light and Power Companies

THE crux of all business is in the end the revenue received by the operating company. Large production and public good will are all very fine in their way, but the inner man cannot be fed by them alone.

The accompanying charts showing the various sources of central-station revenue are based upon data collected by the United States Census Bureau and are for the year 1922. The importance of the domestic and commercial lighting load as a revenue producer is clearly brought out.

It is important to bear in mind, however, that the cost of distributing this portion of the central-station output is comparatively high, although no exact figures are available as to the comparative cost of distributing lighting and distributing industrial power load. It is rather surprising to find that almost one quarter of the central-station revenue comes from other than the domestic, commercial and industrial lighting and power customers on the companies' systems.

There is, of course, a certain amount of duplication in the total revenue of $1,072,119,883, in that the energy sold to other electric light and power companies is reported by both the generating and distributing companies, by one at the wholesale value of the energy and by the other at its retail value. The total, however, does indicate the aggregate financial activities of the electrical industry.

Revenues from electric service in 1922 formed 95.2 per cent of the combined total revenues of the commercial and municipal establishments. For commercial plants the corresponding proportion was 94.9 and for municipal plants 97.8. The revenues from commercial, industrial and domestic light and power service and from energy sold to other electric light and power companies and electric railways increased somewhat in relative importance between the years 1917 and 1922.